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1AC—Inherency

Observation 1 is inherency

Space exploration is inevitable—but current plans disregard further lunar exploration

Logsdon 7-19 (John M. Logsdon, “As Atlantis Glides to Its Final Landing, What Comes Next?” Scientific American, 19 July 2011, <http://www.scientificamerican.com/blog/post.cfm?id=as-atlantis-glides-to-it-final-land-2011-07-19>)

By following the reasoning of the 2009 Augustine Committee, the Obama administration has imposed unneeded constraints on future space planning. The committee concluded that future NASA budgets could only support the development of a new heavy lift launcher and a new spacecraft for deep space expeditions, not also a vehicle to land on another planetary surface, especially the moon. This led the committee to propose a "flexible path" for exploration that bypassed the moon on its way to other distant destinations. The Obama administration embraced this perspective, and President Obama on April 15, 2010, announced that reaching a near-earth asteroid by 2025 should be the initial goal of the next round of human exploration, and that a return to the moon would not be a high priority U.S. objective.

1AC—Plan Text

Plan:

The United States federal government should guarantee funding to establish a Lunar Base dedicated to mining the Moon.

1AC—Exploration Advantage (1/6)

Advantage 1 is Exploration

Species extinction is inevitable as long as we’re trapped on earth—lunar expansion is the critical first step to extending the reach of humanity into the great beyond

Paul D. Lowman Jr.,Research Geophysicist at the Goddard Space Flight Center and PhD in Geology from the University of Colorado, “Why Go Back to the Moon?” Goddard Space Flight Center, 14 January 2008, <http://www.nasa.gov/centers/goddard/news/series/moon/why_go_back.html>

Taking the Los Angeles Times title, "Don’t colonize the Moon," at face value, I will first point out that the Vision for Space Exploration proposes an "outpost" on the Moon. This is hardly colonization in the sense that Europeans colonized North America. Current NASA plans are in a preliminary stage, but envisage something comparable to Little America, or the Amundsen-Scott South Pole base. These terrestrial examples – operated by humans, incidentally – have proven their scientific value over and over, helping to produce valuable evidence about the ozone hole and global warming. The Times editorial echoes identical arguments advanced in the early 1960s, that robotic missions could produce as much as manned ones. The US did in fact have a large robotic lunar program, including 3 Rangers, 5 Surveyors, 5 Lunar Orbiters, and 2 Radio Astronomy Explorers, not counting the few unsuccessful missions. So NASA did use robots in our first lunar program. But as argued at the time, human abilities on the surface later proved far superior to robotic ones. Neil Armstrong and his colleagues demonstrated that humans on the spot provide instant interpretation of their environment, guided by color, 3D, high resolution human vision that is only now being approached by robotic systems. Even encumbered by space suits, they could instantly recognize and collect invaluable samples such as the "Genesis Rock" of Apollo 15, an anorthosite that has proven essential to understanding the geologic history of the Moon. When the Apollo 17 rover lost a fender – which might have terminated a robotic rover’s mission – astronauts Cernan and Schmitt managed a field repair and kept driving. All the Apollo astronauts emplaced complex geophysical instrument stations, most operating for years until budget cuts forced them to be turned off. The Soviet Union carried out several brilliant robotic surface missions, starting with the very first soft landing, Luna 9. The USSR operated two robotic rovers on the Moon for months, and carried out three robotic sample return missions, both accomplishments never matched by the US or any other country. Yet no one would seriously argue that these missions produced anything close to the results of, for example, the Apollo 15 mission. The Apollo 15 astronauts Scott and Irwin returned tens of pounds of rock and soil (including the "Genesis Rock"), drove their rover miles along the front of the lunar Apennines, drilled holes for and emplaced probes for heat flow measurements, and took hundreds of high-resolution photos of their surroundings. Returning to the 21st century: Given these splendid accomplishments by astronauts on the Moon, why bother to go back? Should we not "declare victory" and stay on (or near) Earth? Here are some reasons go back, although not necessarily to "colonize" the Moon. First, and most fundamental: the last few decades of space exploration and astronomy have shown that the universe is violent and dangerous, at least with respect to human life. To give a pertinent example: in 1908 an object of unknown nature – probably a comet – hit Siberia with a force equivalent to a hydrogen bomb. Had this impact happened a few hours later, allowing for the Earth’s rotation, this object would have destroyed St. Petersburg and probably much else. Going back some 65 million years, it is now essentially proven that an even greater impact wiped out not only the dinosaurs but most species living on Earth at the time. The importance of catastrophic impacts has only been demonstrated in recent decades, and space exploration has played a key role. The bleak conclusion to which these facts point is that humanity is vulnerable as long as we are confined to one planet. Obviously, we must increase our efforts to preserve this planet and its biosphere, an effort in which NASA satellites have played a vital role for many years. But uncontrollable external events may destroy our civilization, perhaps our species. We can increase our chances of long-term survival by dispersal to other sites in the solar system. Where can we go? At the moment, human life exists only on the Earth. But with modern technology, there are several other possibilities, starting with the Moon itself. Men have lived on the Moon for as long as three days, admittedly in cramped quarters, but they found the lunar surface easy to deal with and the Moon’s gravity comfortable and helpful. (Dropped tools, for example, didn’t float away into space as they do occasionally in Earth orbit.) To be sure, it would be an enormous and probably impossible task to transform the Moon into another Earth. However, it is clear that a lunar outpost comparable to, for example, the Little America of the 1930s, is quite feasible. But what could such an outpost accomplish? First, it could continue the exploration of the Moon, whose surface area is roughly that of North and South America combined. Six "landings" in North America would have given us only a superficial knowledge of this continent, and essentially none about its natural resources such as minerals, oil, water power, and soil. The Moon is a whole planet, so to speak, whose value is only beginning to be appreciated. The Moon is not only an interesting object of study, but a valuable base for study of the entire Universe, by providing a site for astronomy at all wavelengths from gamma rays to extremely long radio waves.

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1AC—Exploration Advantage (2/6)

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This statement would have been unquestioned 30 years ago. But the succeeding decades of spectacular discoveries by space-based instruments, such as the Hubble Space Telescope, have led many astronomers such as Nobel Laureate John Mather to argue that the Moon can be by-passed, and that instruments in deep space at relatively stable places called Lagrangian points are more effective. A meeting was held at the Space Telescope Science Institute in Baltimore, in November 2006, on "Astrophysics Enabled by the Return to the Moon." This institute runs the Hubble Space Telescope program. However, the consensus emerging from the Baltimore meeting was that there are still valuable astronomical uses for instruments on the lunar surface. For example, low-frequency radio astronomy can only be effective from the far side of the Moon, where static from the Earth’s aurora is shielded. Another example of Moon-based astronomy can be the search for extraterrestrial intelligence (SETI), by radio telescopes that on the far side would be shielded from terrestrial interference. Small telescopes on the Moon’s solid surface could be linked to form interferometer arrays with enormous resolving power. Astronomy in a limited sense has already been done from the Moon, namely the Apollo 16 Ultraviolet telescope emplaced by Apollo astronauts and before that, the simple TV observations of Earth-based lasers by the Surveyor spacecraft. The much-feared lunar dust had no effect on these pioneering instruments. The Moon may offer mineral resources, so to speak, of great value on Earth. Apollo 17 astronaut Harrison Schmitt, working with the Fusion Technology Institute of the University of Wisconsin, has shown that helium 3, an isotope extremely rare on Earth, exists in quantity in the lunar soil, implanted by the solar wind. If – a very big if – thermonuclear fusion for energy is produced on Earth, helium 3 would be extremely valuable for fusion reactors because it does not make the reactor radioactive. A more practicable use of helium 3, being tested at the University of Wisconsin, is the production of short-lived medical isotopes. Such isotopes must now be manufactured in cyclotrons and quickly delivered before they decay. But Dr. Schmitt suggests that small helium 3 reactors could produce such isotopes at the hospital. In any event, research on the use of helium 3 would clearly benefit if large quantities could be exported to the Earth. Returning to the most important reason for a new lunar program, dispersal of the human species, the most promising site for such dispersal is obviously Mars, now known to have an atmosphere and water. Mars itself is obviously a fascinating object for exploration. But it may even now be marginally habitable for astronaut visits, and in the very long view, might be "terraformed," or engineered to have a more Earth-like atmosphere and climate. This was described in Kim Stanley Robinson’s trilogy, Red Mars and its successors Green and Blue Mars. A second Earth, so to speak, would greatly improve our chances of surviving cosmic catastrophes. Where does the Moon fit into this possibility? First, it would continue to give us experience with short interplanetary trips, which is what the Apollo missions were. These would demonstrably be relatively short and safe compared to Mars voyages, but would provide invaluable test flights, so to speak. More important, shelters, vehicles, and other equipment built for the Moon could be over-designed, and with modification could be used on Mars after being demonstrated at a lunar outpost. Where could humanity expand to beyond Mars and the Moon? At this point, still early in the history of space exploration, it is impossible to say. The Galilean satellites of Jupiter, in particular Ganymede, might be habitable, but we venture here far into the field of science fiction. However, an outpost on the Moon is clearly possible, and would provide an invaluable stepping-stone to Mars. A species living on three planets would be far more likely to have a long history than one living only on the Earth. To put the arguments for a return to the Moon, and a lunar outpost, in the most general terms: the Moon is essentially a whole planet, one that has so far been barely touched. But this new planet is only a few days travel away and we have already camped on it. To turn our backs on the Moon would be equivalent to European exploration stopping after Columbus’s few landings, or China’s destruction of its giant ships to concentrate on domestic problems in the 15th century.

Now key—ten to the thirty-second power human lives are lost with each second we delay colonizing space

Nick Bostrom, Professor of Philosophy at Yale, “Astronomical Waste: The Opportunity Cost of Delayed Technological Development,” Utilitas Vol. 15, No. 3 (2003), http://www.nickbostrom.com/astronomical/waste.html

As I write these words, suns are illuminating and heating empty rooms, unused energy is being flushed down black holes, and our great common endowment of negentropy is being irreversibly degraded into entropy on a cosmic scale. These are resources that an advanced civilization could have used to create value-structures, such as sentient beings living worthwhile lives. The rate of this loss boggles the mind. One recent paper speculates, using loose theoretical considerations based on the rate of increase of entropy, that the loss of potential human lives in our own galactic supercluster is at least ~10^46 per century of delayed colonization.[1] This estimate assumes that all the lost entropy could have been used for productive purposes, although no currently known technological mechanisms are even remotely capable of doing that. Since the estimate is meant to be a lower bound, this radically unconservative assumption is undesirable. We can, however, get a lower bound more straightforwardly by simply counting the number or stars in our galactic supercluster and multiplying this number with the amount of computing power that the resources of each star could be used to generate using technologies for whose feasibility a strong case has already been made. We can then divide this total with the estimated amount of computing power needed to simulate one human life. As a rough approximation, let us say the Virgo Supercluster contains 10^13 stars. One estimate of the computing power extractable from a star and with an associated planet-sized computational structure, using advanced molecular nanotechnology[2], is 10^42 operations per second.[3] A typical estimate of the human brain’s processing power is roughly 10^17 operations per second or less.[4] Not much more seems to be needed to simulate the relevant parts of the environment in sufficient detail to enable the simulated minds to have experiences indistinguishable from typical current human experiences.[5] Given these estimates, it follows that the potential for approximately 10^38 human lives is lost every century that colonization of our local supercluster is delayed; or equivalently, about 10^31 potential human lives per second.

1AC—Exploration Advantage (3/6)

Additionally, lunar expansion and basing is critical to sustaining global hegemony—Chinese moves to gain control over lunar resources and strategic points threatens to plunge the globe into authoritarianism

Paul Spudis, Senior Staff Scientist at the Lunar and Planetary Institute and former Deputy Leader of the Science Team for the Department of Defense Clementine mission to the Moon, “The New Space Race,” Space Ref, 2/9/2010, <http://www.spaceref.com/news/viewnews.html?id=1376>

The goal of the VSE is to create the capability to live ON the Moon and OFF its local resources with the goals of self-sufficiency and sustainability, including the production of propellant and refueling of cislunar transport vehicles. A system that is able to routinely go to and from the lunar surface is also able to access any other point in cislunar space. We can eventually export lunar propellant to fueling depots throughout cislunar space, where most of our space assets reside. In short, by going to the Moon, we create a new and qualitatively different capability for space access, a "transcontinental railroad" in space. Such a system would completely transform the paradigm of spaceflight. We would develop serviceable satellites, not ones designed to be abandoned after use. We could create extensible, upgradeable systems, not "use and discard." The ability to transport people and machines throughout cislunar space permits the construction of distributed instead of self-contained systems. Such space assets are more flexible, more capable and more easily defended than conventional ones. The key to this new paradigm is to learn if it is possible to use lunar and space resources to create new capabilities and if so, how difficult it might be. Despite years of academic study, no one has demonstrated resource extraction on the Moon. There is nothing in the physics and chemistry of the materials of the Moon that suggests it is not possible, but we simply do not know how difficult it is or what practical problems might arise. This is why resource utilization is an appropriate goal for the federal space program. As a high-risk engineering research and development project, it is difficult for the private sector to raise the necessary capital to understand the magnitude of the problem. The VSE was conceived to let NASA answer these questions and begin the process of creating a permanent cislunar transportation infrastructure. So where do we stand with the creation of such system? Is such a change in paradigm desirable? Are we still in a "space race" or is that an obsolete concept? The answers to some of these questions are not at all obvious. We must consider them fully, as this information is available to all space faring nations to adopt and adapt for their own uses. A new space race The race to the Moon of the 1960's was an exercise in "soft power" projection. We raced the Soviets to the Moon to demonstrate the superiority of our technology, not only to them, but also to the uncommitted and watching world. The landing of Apollo 11 in July 1969 was by any reckoning a huge win for United States and the success of Apollo gave us technical credibility for the Cold War endgame. Fifteen years after the moon landing, President Reagan advocated the development of a missile defense shield, the so-called Strategic Defense Initiative (SDI). Although disparaged by many in the West as unattainable, this program was taken very seriously by the Soviets. I believe that this was largely because the United States had already succeeded in accomplishing a very difficult technical task (the lunar landing) that the Soviet Union had not accomplished. Thus, the Soviets saw SDI as not only possible, but likely and its advent would render their entire nuclear strategic capability useless in an instant. In this interpretation, the Apollo program achieved not only its literal objective of landing a man on the Moon (propaganda, soft power) but also its more abstract objective of intimidating our Soviet adversary (technical surprise, hard power). Thus, Apollo played a key role in the end of the Cold War, one far in excess of what many scholars believe. Similarly, our two follow-on programs of Shuttle and Station, although fraught with technical issues and deficiencies as tools of exploration, had significant success in pointing the way towards a new paradigm for space. That new path involves getting people and machines to satellite assets in space for construction, servicing, extension and repair. Through the experience of ISS construction, we now know it is possible to assemble very large systems in space from smaller pieces, and we know how to approach such a problem. Mastery of these skills suggests that the construction of new, large distributed systems for communications, surveillance, and other tasks is possible. These new space systems would be much more capable and enabling than existing ones. Warfare in space is not as depicted in science-fiction movies, with flying saucers blasting lasers at speeding spaceships. The real threat from active space warfare is denial of assets and access. Communications satellites are silenced, reconnaissance satellites are blinded, and GPS constellations made inoperative. This completely disrupts command and control and forces reliance on terrestrially based systems. Force projection and coordination becomes more difficult, cumbersome and slower. Recently, China tested an ASAT weapon in space, indicating that they fully understand the military benefits of hard space power. But they also have an interest in the Moon, probably for "soft power" projection ("Flags-and-Footprints") at some level. Sending astronauts beyond low Earth orbit is a statement of their technical equality with the United States, as among space faring nations, only we have done this in the past. So it is likely that the Chinese see a manned lunar mission as a propaganda coup. However, we cannot rule out the possibility that they also understand the Moon's strategic value, as described above. They tend to take a long view, spanning decades, not the short-term view that America favors. Thus, although their initial plans for human lunar missions do not feature resource utilization, they know the technical literature as well as we do and know that such use is possible and enabling. They are also aware of the value of the Moon as a "backdoor" to approach other levels of cislunar space, as the rescue of the Hughes communications satellite demonstrated.

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1AC—Exploration Advantage (4/6)

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The struggle for soft power projection in space has not ended. If space resource extraction and commerce is possible, a significant question emerges - What societal paradigm shall prevail in this new economy? Many New Space advocates assume that free markets and capitalism is the obvious organizing principle of space commerce, but others might not agree. For example, to China, a government-corporatist oligarchy, the benefits of a pluralistic, free market system are not obvious. Moreover, respect for contract law, a fundamental reason why Western capitalism is successful while its implementation in the developing world has had mixed results, does not exist in China. So what shall the organizing principle of society be in the new commerce of space resources: rule of law or authoritarian oligarchy? An American win in this new race for space does not guarantee that free markets will prevail, but an American loss could ensure that free markets would never emerge on this new frontier. Why are we going to the Moon? In one of his early speeches defending the Apollo program, President John F. Kennedy laid out the reasons that America had to go the Moon. Among the many ideas that he articulated, one stood out. He said, "whatever men shall undertake, free men must fully share." This was a classic expression of American exceptionalism, that idea that we must explore new frontiers not to establish an empire, but to ensure that our political and economic system prevails, a system that has created the most freedom and the largest amount of new wealth in the hands of the greatest number of people in the history of the world. This is a statement of both soft and hard power projection; by leading the world into space, we guarantee that space does not become the private domain of powers who view humanity as cogs in their ideological machine, rather than as individuals to be valued and protected. The Vision was created to extend human reach beyond its current limit of low Earth orbit. It made the Moon the first destination because it has the material and energy resources needed to create a true space faring system. Recent data from the Moon show that it is even richer in resource potential than we had thought; both abundant water and near-permanent sunlight is available at selected areas near the poles. We go to the Moon to learn how to extract and use those resources to create a space transportation system that can routinely access all of cislunar space with both machines and people. Such a system is the logical next step in both space security and commerce. This goal for NASA makes the agency relevant to important national interests. A return to the Moon for resource utilization contributes to national security and economic interests as well as scientific ones. There is indeed a new space race. It is just as important and vital to our country's future as the original one, if not as widely perceived and appreciated. It consists of a struggle with both hard and soft power. The hard power aspect is to confront the ability of other nations to deny us access to our vital satellite assets of cislunar space. The soft power aspect is a question: how shall society be organized in space? Both issues are equally important and both are addressed by lunar return. Will space be a sanctuary for science and PR stunts or will it be a true frontier with scientists and pilots, but also miners, technicians, entrepreneurs and settlers? The decisions made now will decide the fate of space for generations. The choice is clear; we cannot afford to relinquish our foothold in space and abandon the Vision for Space Exploration.

Hegemony is great—it ensures global stability prevails against the whims of rising challengers

Zalmay Khalilzad, former US ambassador to the UN and Iraq, still writing the best cards in debate, “The Economy and National Security,” National Review, 8 February 2011, <http://www.nationalreview.com/articles/259024/economy-and-national-security-zalmay-khalilzad?page=1>

American retrenchment could have devastating consequences. Without an American security blanket, regional powers could rearm in an attempt to balance against emerging threats. Under this scenario, there would be a heightened possibility of arms races, miscalculation, or other crises spiraling into all-out conflict. Alternatively, in seeking to accommodate the stronger powers, weaker powers may shift their geopolitical posture away from the United States. Either way, hostile states would be emboldened to make aggressive moves in their regions. As rival powers rise, Asia in particular is likely to emerge as a zone of great-power competition. Beijing’s economic rise has enabled a dramatic military buildup focused on acquisitions of naval, cruise, and ballistic missiles, long-range stealth aircraft, and anti-satellite capabilities. China’s strategic modernization is aimed, ultimately, at denying the United States access to the seas around China. Even as cooperative economic ties in the region have grown, China’s expansive territorial claims — and provocative statements and actions following crises in Korea and incidents at sea — have roiled its relations with South Korea, Japan, India, and Southeast Asian states. Still, the United States is the most significant barrier facing Chinese hegemony and aggression.

1AC—Exploration Advantage (5/6)

Furthermore, space exploration is critical to reinvigorating our defense-industrial base which is key to sustaining economic growth

Rep. David Wu is a member of the Space and Aeronautics Subcommittee on the House Committee on Science, Space, and Technology.”[Pursuing the next giant leap in space exploration”, 7/08/11

In a time of growing debt, people question the value of taxpayer funded federal research. I passionately believe that federal investment in research and development grows our economy, creates jobs and shrinks the federal deficit. Economists say that between 65 and 90 percent of growth in U.S. per-capita income stems from innovation, defined broadly as new products, processes and business models. But we face increased international competition from countries that are investing more in science, technology and education than we are. If we are to once again have a stable economy, we must rededicate ourselves to the investments that make us strong: small business, education, and research and development. Research and development at NASA have resulted in an array of successful products and technologies that touch our daily lives, including heart rate monitors, wireless headsets, and water purification systems. In short, NASA's space program has helped our country become an economic powerhouse.

Governments have an important and appropriate role to play in growing our science and technology capabilities and fostering innovation in our economy. The end of NASA’s shuttle program should not mean the end of our national commitment to exploration, innovation, research and education. While the program has not been without its shortfalls, the privatization of human space flight is simply too risky for an enterprise of national significance. There is certainly a place for the private sector in space flight. Where a market exists or can be created, such as carrying cargo or launching satellites, the private sector can and should predominate. But by privatizing all of current human space flight, we are jeopardizing our nation's leadership in space exploration and we are jeopardizing our children's future. Few people realize that the innovations that brought us vehicles capable of launching into space and returning safely were breakthroughs on par with the microchip: breakthroughs that are not likely to be equaled for a long time. Despite human sacrifices and budget pitfalls, the shuttle program established the United States as the leader in space exploration. It encouraged us to reach for the stars in both our dreams and our actions. It drove innovation and it challenged us to find creative solutions to technological challenges. As we move to the next chapter, it is imperative that we maintain a national role in space exploration. Our children deserve to live in a nation with a vision of the future that matches the dreams of our forbears: a vision that sees a solution to every problem, even if it lies beyond the stars.

1AC—Exploration Advantage (6/6)

Economic decline causes global war

Royal, director of Cooperative Threat Reduction at the U.S. Department of Defense,2010 (Jedediah, Economics of War and Peace: Economic, Legal, and Political Perspectives, pg 213-215)

Less intuitive is how periods of economic decline may increase the likelihood of external conflict. Political science literature has contributed a moderate degree of attention to the impact of economic decline and the security and defense behavior of interdependent states. Research in this vein has been considered at systemic, dyadic and national levels. Several notable contributions follow. First, on the systemic level, Pollins (2008) advances Modelski and Thompson’s (1996) work on leadership cycle theory, finding that rhythms in the global economy are associated with the rise and fall of a pre-eminent power and the often bloody transition from one pre-eminent leader to the next. As such, exogenous shocks such as economic crises could usher in a redistribution of relative power (see also Gilpin, 1981) that leads to uncertainty about power balances, increasing the risk of miscalculation (Fearon 1995). Alternatively, even a relatively certain redistribution of power could lead to a permissive environment for conflicts as a rising power may seek to challenge a declining power (Werner, 1999). Separately, Pollins (1996) also shows that global economic cycles combined with parallel leadership cycles impact the likelihood of conflict among major, medium and small powers, although he suggests that the causes and connections between global economic conditions and security conditions remains unknown. Second, on a dyadic level, Copeland’s (1996, 2000) theory of trade expectations suggest that “future expectation of trade” is a significant variable in understanding economic conditions and security behavior of states. He argues that interdependent states are likely to gain pacific benefits from trade so long as they have an optimistic view of future trade relations. However, if the expectations of future trade decline, particularly for difficult to replace item such as energy resources, the likelihood for conflict increases, as states will be inclined to use force to gain access to those resources. Crises could potentially be the trigger for decreased trade expectations either on its own or because it triggers protectionist moves by interdependent states. Third, others have considered the link between economic decline and external armed conflict at a national level. Blomberg and Hess (2002) find a strong correlation between internal conflict and external conflict, particularly during periods of economic downturn. They write, The linkages between internal and external conflict and prosperity are strong and mutually reinforcing. Economic conflict tends to spawn internal conflict, which in turn returns the favor. Moreover, the presence of a recession tends to amplify the extent to which international and external conflicts self-reinforce each other. (Blomberg and Hess, 2002, p. 89) Economic decline has also been linked with an increase in the likelihood of terrorism (Blomberg, Hess and Weerapana, 2004), which has the capacity to spill across borders and lead to external tensions. Furthermore, crises generally reduce the popularity of a sitting government. “Diversionary theory” suggests that, when facing unpopularity arising from economic decline, sitting governments have increased incentives to fabricate external military conflicts to create a “rally around the flag” effect. Wang (1996), DeRouen (1995) and Blomberg, Hess and Thacker (2006) find supporting evidence showing that economic decline and use of force are at least indirectly correlated. Gelpi (1997), Miller (1999), and Kisangani and Pickering (2009) suggest that the tendency towards diversionary tactics are greater for democratic states than autocratic states due to the fact the democratic leaders are generally more susceptible to being removed from office due to lack of domestic support. De DeRouen (2000) has provided evidence showing that periods of weak economic performance in the United States and thus weak Presidential popularity are statically linked to an increase in the use of force. In summary, recent economic scholarship positively correlates economic integration with an increase in the frequency of economic crises, whereas political science scholarship links economic decline with external conflict at systemic, dyadic and national levels. This implied connection between integration, crises and armed conflict has not featured prominently in economic-security debate and deserves more attention. This observation is not contradictory to other perspectives that link economic interdependence with a decrease in the likelihood of external conflict, such as those mentioned in the first paragraph of this chapter. Those studies tend to focus on dyadic interdependence instead of global interdependence and do not specifically consider the occurrence of and conditions created by economic crises. As such the view presented here should be considered ancillary to those views.

1AC—Energy Advantage (1/8)

Advantage 2 is helium-3

Helium-3 is becoming increasingly rare on Earth, but deposits in lunar soil are plentiful

Barnatt 7-2 (Christopher Barnatt, lecturer, futurist, and associate professor of Computing and Future Studies in Nottingham University Business School, “Helium-3 Power Generation,” Explaining the Future, last updated 2 July 2011, <http://www.explainingthefuture.com/helium3.html>)

One of many problems associated with using helium-3 to create energy via nuclear fusion is that, at least on the Earth, helium-3 is very, very rare indeed. Helium-3 is produced as a by-product of the maintenance of nuclear weapons, which could net a supply of around 15Kg a year. Helium-3 is, however, emitted by the Sun within its solar winds. Our atmosphere prevents any of this helium-3 arriving on the Earth. However, as it does not have an atmosphere, there is nothing to stop helium-3 arriving on the surface of the Moon and being absorbed by the lunar soil. As a result, it has been estimated that there are around 1,100,000 metric tonnes of helium-3 on the surface of the Moon down to a depth of a few metres. This helium-3 could potentially be extracted by heating the lunar dust to around 600 degrees C, before bringing it back to the Earth to fuel a new generation of nuclear fusion power plants. As reported in an Artemis Project paper, about 25 tonnes of helium-3 -- or a fully-loaded Space Shuttle cargo bay's worth -- could power the United States for a year. This means that helium-3 has a potential economic value in the order of $3bn a tonne -- making it the only thing remotely economically viable to consider mining from the Moon given current and likely-near-future space travel technologies and capabilities.

However, other countries are already stepping up to the plate—action now is key to ensure America gets a hefty market share

John Lasker, “Race to the Moon for Nuclear Fuel,” Wired, 12/15/2006, <http://www.wired.com/science/space/news/2006/12/72276>

The isotope is extremely rare on Earth but abundant on the moon. Some experts estimate there a millions of tons in lunar soil -- and that a single Space-Shuttle load would power the entire United States for a year. NASA plans to have a permanent moon base by 2024, but America is not the only nation with plans for a moon base. China, India, the European Space Agency, and at least one Russian corporation, Energia, have visions of building manned lunar bases post-2020. Mining the moon for helium-3 has been discussed widely in space circles and international space conferences. Both China and Russia have stated their nations' interest in helium-3. "We will provide the most reliable report on helium-3 to mankind," Ouyang Ziyuan, the chief scientist of China's lunar program, told a Chinese newspaper. "Whoever first conquers the moon will benefit first." Russian space geologist Erik Galimov told the Russian Izvestia newspaper that NASA's plan to colonize the moon will "enable the U.S. to establish its control of the global energy market 20 years from now and put the rest of the world on its knees as hydrocarbons run out." Schmitt told a Senate committee in 2003 that a return to the moon to stay would be comparable "to the movement of our species out of Africa." The best way to pay for such a long-term mission, he said, would be to mine for lunar helium-3 and process it into a fuel for commercial fusion .

1AC—Energy Advantage (2/8)

Scenario 1 is nuclear smuggling

Helium-3 is critical to identifying nuclear material smuggled for terrorist activities—but shortages have hamstringed effective tracking

Matthew L. Wald, “Shortage Slows a Program to Detect Nuclear Bombs,” New York Times, 22 November 2009, <http://www.nytimes.com/2009/11/23/us/23helium.html>

WASHINGTON — The Department of Homeland Security has spent $230 million to develop better technology for detecting smuggled nuclear bombs but has had to stop deploying the new machines because the United States has run out of a crucial raw material, experts say. The ingredient is helium 3, an unusual form of the element that is formed when tritium, an ingredient of hydrogen bombs, decays. But the government mostly stopped making tritium in 1989. “I have not heard any explanation of why this was not entirely foreseeable,” said Representative Brad Miller, Democrat of North Carolina, who is the chairman of a House subcommittee that is investigating the problem. An official from the Homeland Security Department testified last week before Mr. Miller’s panel, the Investigations and Oversight Subcommittee of the House Science Committee, that demand for helium 3 appeared to be 10 times the supply. Some government agencies, Mr. Miller said, did anticipate a crisis, but the Homeland Security Department appears not to have gotten the message. The department had planned a worldwide network using the new detectors, which were supposed to detect plutonium or uranium in shipping containers. The government wanted 1,300 to 1,400 machines, which cost $800,000 each, for use in ports around the world to thwart terrorists who might try to deliver a nuclear bomb to a big city by stashing it in one of the millions of containers that enter the United States every year. At the White House, Steve Fetter, an assistant director of the Office of Science and Technology Policy, said the helium 3 problem was short-term because other technologies would be developed. But, he said, while the government had a large surplus of helium 3 at the end of the cold war, “people should have been aware that this was a one-time windfall and was not sustainable.” Helium 3 is not hazardous or even chemically reactive, and it is not the only material that can be used for neutron detection. The Homeland Security Department has older equipment that can look for radioactivity, but it does not differentiate well between bomb fuel and innocuous materials that naturally emit radiation — like cat litter, ceramic tiles and bananas — and sounds false alarms more often. Earlier this year, the Pacific Northwest National Laboratory, part of the Energy Department, said in a report, “No other currently available detection technology offers the stability, sensitivity and gamma/neutron discrimination” of detectors using helium 3. Helium 3 is used to detect neutrons, the subatomic particles that sustain the chain reaction in a bomb or a reactor. Plutonium, the favorite bomb-making material of most governments with nuclear weapons, intermittently gives off neutrons, which are harder for a smuggler to hide than other forms of radiation. (Detecting the alternative bomb fuel, enriched uranium, is a separate, difficult problem, experts say.)

1AC—Energy Advantage (3/8)

Nuclear terrorism escalates to global nuclear exchange

Robert Ayson, Professor of Strategic Studies and Director of the Centre for Strategic Studies: New Zealand at the Victoria University of Wellington, “After a Terrorist Nuclear Attack: Envisaging Catalytic Effects,” Studies in Conflict & Terrorism, Volume 33, Issue 7, July 2010, informaworld

A terrorist nuclear attack, and even the use of nuclear weapons in response by the country attacked in the first place, would not necessarily represent the worst of the nuclear worlds imaginable. Indeed, there are reasons to wonder whether nuclear terrorism should ever be regarded as belonging in the category of truly existential threats. A contrast can be drawn here with the global catastrophe that would come from a massive nuclear exchange between two or more of the sovereign states that possess these weapons in significant numbers. Even the worst terrorism that the twenty-first century might bring would fade into insignificance alongside considerations of what a general nuclear war would have wrought in the Cold War period. And it must be admitted that as long as the major nuclear weapons states have hundreds and even thousands of nuclear weapons at their disposal, there is always the possibility of a truly awful nuclear exchange taking place precipitated entirely by state possessors themselves. But these two nuclear worlds—a non-state actor nuclear attack and a catastrophic interstate nuclear exchange—are not necessarily separable. It is just possible that some sort of terrorist attack, and especially an act of nuclear terrorism, could precipitate a chain of events leading to a massive exchange of nuclear weapons between two or more of the states that possess them. In this context, today’s and tomorrow’s terrorist groups might assume the place allotted during the early Cold War years to new state possessors of small nuclear arsenals who were seen as raising the risks of a catalytic nuclear war between the superpowers started by third parties. These risks were considered in the late 1950s and early 1960s as concerns grew about nuclear proliferation, the so-called n+1 problem. t may require a considerable amount of imagination to depict an especially plausible situation where an act of nuclear terrorism could lead to such a massive inter-state nuclear war. For example, in the event of a terrorist nuclear attack on the United States, it might well be wondered just how Russia and/or China could plausibly be brought into the picture, not least because they seem unlikely to be fingered as the most obvious state sponsors or encouragers of terrorist groups. They would seem far too responsible to be involved in supporting that sort of terrorist behavior that could just as easily threaten them as well. Some possibilities, however remote, do suggest themselves. For example, how might the United States react if it was thought or discovered that the fissile material used in the act of nuclear terrorism had come from Russian stocks,40 and if for some reason Moscow denied any responsibility for nuclear laxity? The correct attribution of that nuclear material to a particular country might not be a case of science fiction given the observation by Michael May et al. that while the debris resulting from a nuclear explosion would be “spread over a wide area in tiny fragments, its radioactivity makes it detectable, identifiable and collectable, and a wealth of information can be obtained from its analysis: the efficiency of the explosion, the materials used and, most important … some indication of where the nuclear material came from.”41 Alternatively, if the act of nuclear terrorism came as a complete surprise, and American officials refused to believe that a terrorist group was fully responsible (or responsible at all) suspicion would shift immediately to state possessors. Ruling out Western ally countries like the United Kingdom and France, and probably Israel and India as well, authorities in Washington would be left with a very short list consisting of North Korea, perhaps Iran if its program continues, and possibly Pakistan. But at what stage would Russia and China be definitely ruled out in this high stakes game of nuclear Cluedo? In particular, if the act of nuclear terrorism occurred against a backdrop of existing tension in Washington’s relations with Russia and/or China, and at a time when threats had already been traded between these major powers, would officials and political leaders not be tempted to assume the worst? Of course, the chances of this occurring would only seem to increase if the United States was already involved in some sort of limited armed conflict with Russia and/or China, or if they were confronting each other from a distance in a proxy war, as unlikely as these developments may seem at the present time. The reverse might well apply too: should a nuclear terrorist attack occur in Russia or China during a period of heightened tension or even limited conflict with the United States, could Moscow and Beijing resist the pressures that might rise domestically to consider the United States as a possible perpetrator or encourager of the attack? Washington’s early response to a terrorist nuclear attack on its own soil might also raise the possibility of an unwanted (and nuclear aided) confrontation with Russia and/or China. For example, in the noise and confusion during the immediate aftermath of the terrorist nuclear attack, the U.S. president might be expected to place the country’s armed forces, including its nuclear arsenal, on a higher stage of alert. In such a tense environment, when careful planning runs up against the friction of reality, it is just possible that Moscow and/or China might mistakenly read this as a sign of U.S. intentions to use force (and possibly nuclear force) against them. In that situation, the temptations to preempt such actions might grow, although it must be admitted that any preemption would probably still meet with a devastating response.

1AC—Energy Advantage (4/8)

Scenario 2 is nuclear fusion

Helium-3 is the key to utilizing nuclear fusion for incredibly clean and efficient power generation—one shuttle-load alone could power the United States for a year

Barnatt 7-2 (Christopher Barnatt, lecturer, futurist, and associate professor of Computing and Future Studies in Nottingham University Business School, “Helium-3 Power Generation,” Explaining the Future, last updated 2 July 2011, <http://www.explainingthefuture.com/helium3.html>)

Helium-3 (He3) is gas that has the potential to be used as a fuel in future nuclear fusion power plants. There is very little helium-3 available on the Earth. However, there are thought to be significant supplies on the Moon. Several governments have subsequently signalled their intention to go to the Moon to mine helium-3 as a fuel supply. Such plans may come to fruition within the next two to three decades and trigger a new Space Race. In addition to the information below, you can also find out more about this topic from the Mining Helium-3 On the Moon video or in my interview on "the new space race and mining the moon for helium 3" available from my BBC Nottingham Profile Page. There is also some great information on this topic over at Helium-3.us. Oh, and you can even read the website and play the game at Helium3Game.com from Discovery Channel, and on which I worked as a consultant. Helium-3 and Nuclear Fusion To provide a little background -- and without getting deeply into the science -- all nuclear power plants use a nuclear reaction to produce heat. This is used to turn water into steam that then drives a turbine to produce electricity. Current nuclear power plants have nuclear fission reactors in which uranium nuclei are split part. This releases energy, but also radioactivity and spent nuclear fuel that is reprocessed into uranium, plutonium and radioactive waste which has to be safety stored, effectively indefinitely. An overview of this nuclear fuel cycle can be found here. For over 40 years scientists have been working to create nuclear power from nuclear fusion rather than nuclear fission. In current nuclear fusion reactors, the hydrogen isotopes tritium and deuterium are used as the fuel, with atomic energy released when their nuclei fuse to create helium and a neutron. Nuclear fusion effectively makes use of the same energy source that fuels the Sun and other stars, and does not produce the radioactivity and nuclear waste that is the by-product of current nuclear fission power generation. However, the so-termed "fast" neutrons released by nuclear fusion reactors fuelled by tritium and deuterium lead to significant energy loss and are extremely difficult to contain. One potential solution may be to use helium-3 and deuterium as the fuels in "aneutronic" (power without neutrons) fusion reactors. The involved nuclear reaction here when helium-3 and deuterium fuse creates normal helium and a proton, which wastes less energy and is easier to contain. Nuclear fusion reactors using helium-3 could therefore provide a highly efficient form of nuclear power with virtually no waste and no radiation. A short wall chart explaining this in more detail can be found here. The aforementioned fission, fusion and aneutronic fusion nuclear reactions are also illustrated in animations in my Mining Helium-3 On the Moon video. Mining Helium-3 on the Moon One of many problems associated with using helium-3 to create energy via nuclear fusion is that, at least on the Earth, helium-3 is very, very rare indeed. Helium-3 is produced as a by-product of the maintenance of nuclear weapons, which could net a supply of around 15Kg a year. Helium-3 is, however, emitted by the Sun within its solar winds. Our atmosphere prevents any of this helium-3 arriving on the Earth. However, as it does not have an atmosphere, there is nothing to stop helium-3 arriving on the surface of the Moon and being absorbed by the lunar soil. As a result, it has been estimated that there are around 1,100,000 metric tonnes of helium-3 on the surface of the Moon down to a depth of a few metres. This helium-3 could potentially be extracted by heating the lunar dust to around 600 degrees C, before bringing it back to the Earth to fuel a new generation of nuclear fusion power plants. As reported in an Artemis Project paper, about 25 tonnes of helium-3 -- or a fully-loaded Space Shuttle cargo bay's worth -- could power the United States for a year. This means that helium-3 has a potential economic value in the order of $3bn a tonne -- making it the only thing remotely economically viable to consider mining from the Moon given current and likely-near-future space travel technologies and capabilities.

1AC—Energy Advantage (5/8)

Fusion’s the best solution to global warming

Charles Arthur, “Nuclear fusion: power to the people?” The Register, 6 July 2005, <http://www.theregister.co.uk/2005/07/06/nuclear_fusion/>

Analysis It's G8 week, and climate change is high on the agenda. And now that even George Bush has acknowledged that climate change is (a) happening and (b) is at least partly due to humans but insisted it (c) should be tackled through technology, why not focus again on a technology that's (1) happening and (2) partly controlled by humans? That is, nuclear fusion. Unlike fission, already used to produce most of France's electricity, fusion isn't commercial yet. Even its most positive advocates reckon it'll be more than 25 years before a fusion reactor could contribute usefully to the power grid ("useful" being defined as a steady output of 1 gigawatt; the UK has about 42 GW of installed electric plant). But it does have one very important advocate, and another who is coming along for the ride, and they're both G8 leaders. The advocate: Tony Blair. The one along for the ride: George Bush. Plus it also involves two other G8 nations, France and Japan, directly, as they'll get tons of money from contracts to build the next stage in the long, long road to commercial fusion. Last week France was chosen as the site for the International Thermonuclear Experimental Reactor (Iter) project, beating Japan's bid. If it works, ITER will take in 50 megawatts of power and put out between 500 and 1,000 MW. That's right - it could power itself. Here's how. Fusion is what powers the stars. They burn by slamming two hydrogen nuclei (protons) together, to produce a helium nucleus (two protons) and some extra particles. (See the whole system here.) On Earth, we cheat a little by fusing a nucleus of deuterium (hydrogen with a neutron aboard) with one of tritium (hydrogen with two neutrons), to produce a helium nucleus plus lots of energy in the form of a "fast" neutron. Simple on paper; fiendishly hard in practice. You have to heat the material to about 100 million Centigrade until it becomes "plasma", confine it using magnetic fields, and compress it so fiercely that you overcome the natural tendency of nuclei to repel each other as fiercely as Steve Ballmer encountering an iPod. Deuterium is plentiful. There's enough in a bath to generate all the energy you'd need in your lifetime. Tritium is trickier, produced either from deuterium fusion, or other decay products. It's used in nuclear weapons, exit signs that work without power, and some illuminated watches. If you can control the fusion reaction and keep it going, you produce huge amounts of "fast" neutrons which heat up the reactor vessel. That heat can produce steam which can turn turbines to generate electricity. Nuclear waste? Well, the reactor walls might be a little radioactive after you stop; but in 10 years' time you could reuse the parts in another reactor. Tritium is poisonous, but wouldn't get out. And the reaction can't run away like fission can; if the magnetic "bottle" fails, the reaction stops.

Unchecked warming causes extinction

Fred Pearce, published author and journalist that was UK environment journalist of the year, With Speed And Violence: Why Scientists Fear Tipping Points in Climate Change, 2007, p. 240

Fifteen years on, the urgency of the climate crisis is much clearer, even if the story has grown a little more complicated. But we are showing no signs yet of acting on the scale necessary. The technology is still straight­forward, and the economics is only easier, but we can't get the politics right. Even at this late hour, I do believe we have it in our power to set Spaceship Earth back on the right course. But time is short. The ship is al­ready starting to spin out of control. We may soon lose all chance of grab­bing the wheel. Humanity faces a genuinely new situation. It is not an environmental crisis in the accepted sense. It is a crisis for the entire life-support system of our civilization and our species. During the past 10,000 years, since the close of the last ice age, human civilizations have plundered and destroyed their local environments, wrecking the natural fecundity of sizable areas of the planet. Nevertheless, the planet's life-support system as a whole has until now remained stable. As one civilization fell, another rose. But the rules of the game have changed. In the Anthropocene, human influences on planetary systems are global and pervasive. In the past, if we got things wrong and wrecked our environment, we could pack up and move somewhere else. Migration has always been one of our species' great survival strategies. Now we have nowhere else to go. No new frontier. We have only one atmosphere; only one planet.

1AC—Energy Advantage (6/8)

Furthermore, population expansion and limited fossil fuel reserves make massive energy crises inevitable—only fusion solves

Kulcinski and Schmitt 2k (Gerald L. Kulcinski and Harrison H. Schmitt, Fusion Technology Institute at the Department of Engineering Physics at the University of Wisconsin-Madison, “Nuclear Power Without Radioactive Waste—The Promise of Lunar Helium-3,” presented at the Second Annual Lunar Development Conference, 20-21 July 2000, <http://fti.neep.wisc.edu/FTI/pdf/fdm1131.pdf>)

The impending world energy crisis of 21st century will require innovative solutions and massive action if we are to avoid a collapse of the Earth’s economic system as we know it. Because of expanding populations, increased standards of living, and increasing aspirations in the developing nations, experts now predict that the Earth’s energy supplies will have to expand by factors of 3 to 6 in the next 50-100 years.1,2 It is widely understood that the 21st century will be the last one in which fossil fuels will play (or at least should play) a dominant role. As we move toward the middle of this century, liquid and gaseous fossil fuels will become scarce and more expensive while greenhouse gas emissions may limit the practical usefulness of coal. Hydroelectric facilities, already under fire from environmental activists, will not be able to expand fast enough to fill the gap and terrestrial renewable resources (geothermal, wind, solar, and biomass) will likely satisfy only local needs on an intermittent basis. Of the known energy sources available to society today, only nuclear energy in the form of fission or fusion can fill the enormous energy needs of the 21st century and beyond. There is enough energy in fissionable material to satisfy the world’s needs for hundreds of years if used in breeder reactors.3 However, the fission industry (at least in the United States) is currently wrestling with the problem of long-lived nuclear waste and is essentially stymied by institutional problems and public acceptance. The use of first-generation thermonuclear fuels, based on the deuterium (D) and tritium (T) fuel cycle, can also provide the necessary energy for centuries to come but the economics of such systems is uncertain4 and the DT fuels will only go part way towards solving the nuclear waste problem. It is the objective of this paper to show that there is a solution to the world’s energy dilemma that can eventually solve the current major problems facing nuclear energy. It will also be shown that this solution will allow future generations to enjoy the benefits of nuclear energy without the problems of long-lived nuclear waste or the risk of accidental release of radioactive materials.

1AC—Energy Advantage (7/8)

Resource shortages create global instability which risks escalation to all-out war

Michael T. Klare, professor of peace and world security studies at Hampshire College, “The Coming Resource Wars,” 10 March 2006, http://www.alternet.org/environment/33243?page=1

It's official: the era of resource wars is upon us. In a major London address, British Defense Secretary John Reid warned that global climate change and dwindling natural resources are combining to increase the likelihood of violent conflict over land, water and energy. Climate change, he indicated, "will make scarce resources, clean water, viable agricultural land even scarcer" -- and this will "make the emergence of violent conflict more rather than less likely." Although not unprecedented, Reid's prediction of an upsurge in resource conflict is significant both because of his senior rank and the vehemence of his remarks. "The blunt truth is that the lack of water and agricultural land is a significant contributory factor to the tragic conflict we see unfolding in Darfur," he declared. "We should see this as a warning sign." Resource conflicts of this type are most likely to arise in the developing world, Reid indicated, but the more advanced and affluent countries are not likely to be spared the damaging and destabilizing effects of global climate change. With sea levels rising, water and energy becoming increasingly scarce and prime agricultural lands turning into deserts, internecine warfare over access to vital resources will become a global phenomenon. Reid's speech, delivered at the prestigious Chatham House in London (Britain's equivalent of the Council on Foreign Relations), is but the most recent expression of a growing trend in strategic circles to view environmental and resource effects -- rather than political orientation and ideology -- as the most potent source of armed conflict in the decades to come. With the world population rising, global consumption rates soaring, energy supplies rapidly disappearing and climate change eradicating valuable farmland, the stage is being set for persistent and worldwide struggles over vital resources. Religious and political strife will not disappear in this scenario, but rather will be channeled into contests over valuable sources of water, food and energy. Prior to Reid's address, the most significant expression of this outlook was a report prepared for the U.S. Department of Defense by a California-based consulting firm in October 2003. Entitled "An Abrupt Climate Change Scenario and Its Implications for United States National Security," the report warned that global climate change is more likely to result in sudden, cataclysmic environmental events than a gradual (and therefore manageable) rise in average temperatures. Such events could include a substantial increase in global sea levels, intense storms and hurricanes and continent-wide "dust bowl" effects. This would trigger pitched battles between the survivors of these effects for access to food, water, habitable land and energy supplies. "Violence and disruption stemming from the stresses created by abrupt changes in the climate pose a different type of threat to national security than we are accustomed to today," the 2003 report noted. "Military confrontation may be triggered by a desperate need for natural resources such as energy, food and water rather than by conflicts over ideology, religion or national honor." Until now, this mode of analysis has failed to command the attention of top American and British policymakers. For the most part, they insist that ideological and religious differences -- notably, the clash between values of tolerance and democracy on one hand and extremist forms of Islam on the other -- remain the main drivers of international conflict. But Reid's speech at Chatham House suggests that a major shift in strategic thinking may be under way. Environmental perils may soon dominate the world security agenda. This shift is due in part to the growing weight of evidence pointing to a significant human role in altering the planet's basic climate systems. Recent studies showing the rapid shrinkage of the polar ice caps, the accelerated melting of North American glaciers, the increased frequency of severe hurricanes and a number of other such effects all suggest that dramatic and potentially harmful changes to the global climate have begun to occur. More importantly, they conclude that human behavior -- most importantly, the burning of fossil fuels in factories, power plants, and motor vehicles -- is the most likely cause of these changes. This assessment may not have yet penetrated the White House and other bastions of head-in-the-sand thinking, but it is clearly gaining ground among scientists and thoughtful analysts around the world. For the most part, public discussion of global climate change has tended to describe its effects as an environmental problem -- as a threat to safe water, arable soil, temperate forests, certain species and so on. And, of course, climate change is a potent threat to the environment; in fact, the greatest threat imaginable. But viewing climate change as an environmental problem fails to do justice to the magnitude of the peril it poses.

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1AC—Energy Advantage (8/8)

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As Reid's speech and the 2003 Pentagon study make clear, the greatest danger posed by global climate change is not the degradation of ecosystems per se, but rather the disintegration of entire human societies, producing wholesale starvation, mass migrations and recurring conflict over resources. "As famine, disease, and weather-related disasters strike due to abrupt climate change," the Pentagon report notes, "many countries' needs will exceed their carrying capacity" -- that is, their ability to provide the minimum requirements for human survival. This "will create a sense of desperation, which is likely to lead to offensive aggression" against countries with a greater stock of vital resources. "Imagine eastern European countries, struggling to feed their populations with a falling supply of food, water, and energy, eyeing Russia, whose population is already in decline, for access to its grain, minerals, and energy supply." Similar scenarios will be replicated all across the planet, as those without the means to survival invade or migrate to those with greater abundance -- producing endless struggles between resource "haves" and "have-nots." It is this prospect, more than anything, that worries John Reid. In particular, he expressed concern over the inadequate capacity of poor and unstable countries to cope with the effects of climate change, and the resulting risk of state collapse, civil war and mass migration. "More than 300 million people in Africa currently lack access to safe water," he observed, and "climate change will worsen this dire situation" -- provoking more wars like Darfur. And even if these social disasters will occur primarily in the developing world, the wealthier countries will also be caught up in them, whether by participating in peacekeeping and humanitarian aid operations, by fending off unwanted migrants or by fighting for access to overseas supplies of food, oil, and minerals. When reading of these nightmarish scenarios, it is easy to conjure up images of desperate, starving people killing one another with knives, staves and clubs -- as was certainly often the case in the past, and could easily prove to be so again. But these scenarios also envision the use of more deadly weapons. "In this world of warring states," the 2003 Pentagon report predicted, "nuclear arms proliferation is inevitable." As oil and natural gas disappears, more and more countries will rely on nuclear power to meet their energy needs -- and this "will accelerate nuclear proliferation as countries develop enrichment and reprocessing capabilities to ensure their national security." Although speculative, these reports make one thing clear: when thinking about the calamitous effects of global climate change, we must emphasize its social and political consequences as much as its purely environmental effects. Drought, flooding and storms can kill us, and surely will -- but so will wars among the survivors of these catastrophes over what remains of food, water and shelter. As Reid's comments indicate, no society, however affluent, will escape involvement in these forms of conflict. We can respond to these predictions in one of two ways: by relying on fortifications and military force to provide some degree of advantage in the global struggle over resources, or by taking meaningful steps to reduce the risk of cataclysmic climate change. No doubt there will be many politicians and pundits -- especially in this country -- who will tout the superiority of the military option, emphasizing America's preponderance of strength. By fortifying our borders and sea-shores to keep out unwanted migrants and by fighting around the world for needed oil supplies, it will be argued, we can maintain our privileged standard of living for longer than other countries that are less well endowed with instruments of power. Maybe so. But the grueling, inconclusive war in Iraq and the failed national response to Hurricane Katrina show just how ineffectual such instruments can be when confronted with the harsh realities of an unforgiving world. And as the 2003 Pentagon report reminds us, "constant battles over diminishing resources" will "further reduce [resources] even beyond the climatic effects." Military superiority may provide an illusion of advantage in the coming struggles over vital resources, but it cannot protect us against the ravages of global climate change. Although we may be somewhat better off than the people in Haiti and Mexico, we, too, will suffer from storms, drought and flooding. As our overseas trading partners descend into chaos, our vital imports of food, raw materials and energy will disappear as well. True, we could establish military outposts in some of these places to ensure the continued flow of critical materials -- but the ever-increasing price in blood and treasure required to pay for this will eventually exceed our means and destroy us. Ultimately, our only hope of a safe and secure future lies in substantially reducing our emissions of greenhouse gases and working with the rest of the world to slow the pace of global climate change.

1AC—Solvency (1/2)

Observation 2 is solvency

A NASA-led return to the moon is entirely feasible and catalyzes public and private investment to retrieve its natural resources

Paul D. Spudis, Senior Staff Scientist at the Lunar and Planetary Institute and former Deputy Leader of the Science Team for the Department of Defense Clementine mission to the Moon, “Can NASA Get Its Groove Back?” Air & Space, 6 November 2010, http://blogs.airspacemag.com/moon/2010/11/can-nasa-get-its-groove-back/

Remember when space exploration was “groovy” and excitement about seeing humans explore the Solar System within our lifetimes was palpable? What happened to NASA and America’s dream to boldly go? The pathway that assured us that space exploration is cool, amazing and pushes excellence has disappeared, littered instead by U-turns and Stop signs. NASA’s groove was the right stuff. When did vanish? Can we get it back? America’s rhythm is stalled. Movement in our economy is going the wrong way. Education standards are mediocre. We’re not evolving. We’re not in our groove. And the country feels it. Is NASA’s dilemma symptomatic of what ails us? “If we could put a man on the Moon..” has become cliché but was the zenith of American exceptionalism. The last time a human walked on the Moon was in December 1972 – 38 years ago next month. NASA has long since stopped getting “free drinks” from the retelling of that decades old conquest. It’s time to light the fire again and do something profound, this time something cumulative and lasting. Conquering the Moon is where we found our groove and if we choose, where we can reclaim it. NASA languished a year waiting to hear what, where and when their mission would be. They’re still waiting, as NASA ponders how to proceed on the “Flexible Path” to their ultimate goal of Mars. Congress recessed without passing a federal budget for 2011 and NASA is operating under a continuing resolution. Things are certainly flexible. The latest buzz in the space blogosphere is about the recent midterm election results and subsequent changes in House committees with Republicans in the majority. After these new committee chairs take charge, will they set new priorities? Only time will tell but past statements by those mentioned to fill these positions give some clues. They seem less inclined to “sell the farm,” thereby giving control of U.S. space access to foreign entities. They seem to be cautious about handing the reins of LEO access to commercial start-ups, preferring to have them prove themselves first, while at the same time guaranteeing that NASA retains the infrastructure necessary to assure our national interests in space. Will their priorities for NASA rest more with the agency staying as a national economic and security asset and less as an international outreach program, heavily influenced by Earth science concerns? Much rests on the decisions made and the money appropriated by the incoming Congress. The current administration’s decision to abandon NASA’s mission of resource utilization on the Moon needs to be revisited. The ability of the United States to routinely access cislunar space through the use of the Moon and its resources needs to be well understood and addressed. We cannot afford to remain complacent about the Moon while other countries move forward to reap the rewards of lunar return. The United States needs to make smart investments that will pay long-term dividends. Lunar return is one of those economic and technological investments. The majority of the panel of engineers and scientists invited to speak at the recent Space Manufacturing conference meeting at NASA’s Ames Research Center (sponsored by the Space Studies Institute) held the view that lunar mining was the logical next move and that government needed to “prime the pump” and demonstrate that this was possible before private enterprise would follow. We need private sector money to fully pursue the purpose and realize the potential of space exploration. NASA needs to show that resource utilization is possible on the Moon. Once we understand how to access and develop lunar resources, private enterprise will capitalize on these findings. As the door to a sustainable space faring infrastructure finally swings open, the tyranny of the rocket equation will be broken. It is time for America to find its groove again. It is time to extol the right stuff and pursue goals of national excellence. Setting a goal that may be obtained in 30 years is not a space program. A return to the Moon to learn how to use its resources is achievable using existing technology and within the decade-long timescales demanded by our political process.

1AC—Solvency (2/2)

Exploration of non-earth celestial bodies solves for recourse wars, humanitarian and environmental challenges, and the economy. The time for a fundamental change to create a better future is now. Only plan solves.

Whitesides 08 (George T. Whitesides executive director national space society before the subcommittee on space, aeronautics, and related sciences, Senate Hearing on “Reauthorizing the Vision for Space Exploration” May 7, 2008 Chairman Nelson, Ranking Member Vitter, and members of the subcommittee. <http://www.spaceref.com/news/viewsr.html?pid=27921> )

The first theme anchors the Vision to the real challenges facing America today, creating real sustainability. That, in turn, will help build public understanding and support for NASA’s mission. The second utilizes the full powers of the American entrepreneur, creating dynamics that over time will grow our economy, lower the cost of space access, and enable NASA to focus its own efforts and funds on exploration of the frontiers. Both themes will ultimately support the sustainable expansion of our civilization outward to the Moon, Mars and beyond, and the expansion of the Earth’s economic sphere to include those bodies.

Ultimately, space is the main path forward to resolving the great humanitarian and environmental challenge of our time – the global disparity between rich and poor. One of our members, James Martin of Springfield Virginia, captured the real scope of the issue at hand: It seems to me that the great challenge facing the world in the coming decades is a growing contention for resources - most acutely energy - between the industrialized world (the "haves") and those rapidly industrializing countries (the current "have nots") that seek a lifestyle similar to ours. China and India, with the world's two largest national populations, are leading this quite natural urge of the "have nots" to improve their lot in life. This is leading to increased demand on global resources by economic growth in these two countries - a situation that can only get worse. It has been said that we would need three Earths to provide the energy and mineral resources to support the entire human population at a standard of living equal to the current industrialized countries (who make up only 1/6 of the planet's population). This leads to a grim conclusion that the "haves" will increasingly have to fight to defend their current advantaged position (a dubious moral proposition), or we will have to change the "playing field" by accessing energy and mineral resources beyond this planet. Moreover, fossil fuels cannot support a massive increase in global industrialization without pushing us even further into environmental collapse.

There has never been a better time for a fundamental change in our perception of the future. If mankind can access resources beyond Earth, we can offer the hope of economic well-being and a clean environment for all, and avoid debilitating future resource conflicts that will only make us all poorer. America's space program must be oriented toward creating this future.

Inherency

Obama is destroying NASA’s lunar ambitions

Hatch 10 (Hatch, Benjamin D. Executive Notes and Comments Editor, Emory International Law Review. “DIVIDING THE PIE IN THE SKY: THE NEED FOR A NEW LUNAR RESOURCES REGIME.” Vol. 24 Rev. 229. 2010. <http://www.gpo.gov/fdsys/pkg/CHRG-108hhrg92757/pdf/CHRG-108hhrg92757.pdf>.

The United States of America is a key player in the future of the Moon. Of all spacefaring nations, only the United States has actually had its citizens reach the Moon. The first Moon landing was made on July 20, 1969.64 The United States made several return visits later in 1969, 1971, and 1972.65 No humans have set foot on the Moon since 1972.66 On January 14, 2004, United States President George W. Bush announced a “new vision”67 for space exploration. This vision included a commitment to return to the Moon between 2015 and 2020.68 During this time, astronauts would be “living and working [on the Moon] for increasingly extended periods.”69 This increased human presence on the Moon would serve as an “important step for . . . more ambitious missions,” beginning with a visit to the planet Mars.70

Towards this end, the National Aeronautics and Space Administration (“NASA”) announced plans for a permanent lunar base on December 5, 2006.71 NASA’s goal was to permanently staff this base by 2024.72 The staff would have “rotat[ed] in and out, as is done with the international space station.”73 To achieve this return to the Moon, NASA began the Constellation Program: a program that would develop both a new series of rockets as well as a new type of spacecraft that would be more conducive to travel to the Moon.74 The Constellation Program would consequently signal the end of NASA’s focus on the space shuttle program.75

One of NASA’s explicitly stated aims for this planned return to the Moon was to “[e]stablish one or more alternative energy sources for Earth based on lunar resources. Potential energy sources include Helium-3 mining for use in fusion reactors on Earth and supplying materials and components for assembly and operation of space solar power satellites . . . .”76 NASA’s lunar ambitions have suffered a setback following the accession of the administration of President Barack Obama. Shortly after his inauguration, the President summoned a panel of experts unaffiliated with NASA to review the agency’s lunar ambitions.77 In September 2009, that panel argued that the Obama administration should reject plans for a return to the Moon based on high costs associated with the trip.78 Additionally, the President’s proposed Congressional budget for 2011 includes $2.5 billion for the purpose of ending the Constellation Program.79

Dire as this may look for the future prospects of an American return to the Moon, a few observations must be made. First, there is reason to believe that the budgetary projection may not actually be the final word on the future of American lunar ambitions. During the 2008 presidential campaign, then Senator Obama stated that he intended to divert funding for the Constellation Program to public education, while ten months later he advocated increasing NASA’s budget to facilitate its lunar ambitions.80 While this inconsistency is reflective of the difficulty inherent in establishing a workable political platform, it also reflects the problem in striking the correct balance between the need to have a hand in the future of lunar resources while trying to keep costs manageable. As a result, it is entirely possible that this balance may again be reconsidered and that, as a result, the Constellation Program may continue.

It is also worth noting that NASA’s current administrator has made statements that the Constellation Program will be replaced by a new program focused on a Mars landing without visiting the Moon.81 It is difficult to understand how this program will succeed without the budget of the Constellation Program or without using the Moon as an intermediate launching point for future Mars visits (which was one of the goals of the Constellation Program82). Ultimately, if NASA has serious desires to explore deeper into the solar system, it is probable that this exploration will be made possible only by a revival of a program designed to place humans on the Moon. Furthermore, it must be noted that, irrespective of American decisions, the rest of the countries described in this section remain committed to landing on the Moon and exploiting its resources. It is in the national security, energy, and economic interests of the United States to have a hand in the disposition of the lunar resources that the other great powers will be seeking.

UQ—Leadership Declining

Other countries are making progress in space, time key to keep US leadership

Griffin, 2005 (Micheal Griffin NASA Administrator, National Aeronautics and Space Administration, NASA team leader for US Vision for Space Exploaration, Fellow of ASS and AIAA, Leadership in Space, 12/6/05, <http://www.freerepublic.com/focus/f-news/1537483/posts>)

But, as they say, that was then and this is now. We cannot rest on nor be satisfied with past accomplishments. The true space age, in which humans will explore the worlds beyond our own, is just getting underway. Leadership in establishing a human presence in the Solar System will, in my judgment, be a key factor in defining world leadership back home on Earth for generations to come. Throughout history, the great civilizations have always extended the frontiers of their times. Indeed, this is almost a tautology; we define as "great" only those civilizations which did explore and expand their frontiers, thereby ultimately influencing world culture. And when, inevitably, some societies retreated from the frontiers they had pioneered, their greatness subsided as well. Today, other nations besides our own aspire to leadership on the space frontier. These nations are making progress, and they will undoubtedly utilize their advancements in space to influence world affairs. Their activities will earn them the respect, which is both sincere and automatic, that is accorded to nations and societies engaged in pioneering activities. These things are not in doubt, and so the question before us is this: when other nations reach the Moon, or Mars, or the worlds beyond, will they be standing with the United States, or will we be watching their exploits on television? The President has given us his answer. America will lead. Nearly two years ago, the President said, "We have undertaken space travel because the desire to explore and understand is part of our character. And that quest has brought tangible benefits that improve our lives in countless ways." He also said our Vision for Space exploration is a "journey, not a race." These words are unambiguous. They chart a course for action that is unmistakable. It is imperative that this commitment transcend any given Administration and any given Congress. Today, as other countries renew their commitment to space, America has the opportunity, and I would argue the obligation, to maintain our leadership role in space exploration. As we watch other countries commit to developing new exploration systems and technologies to expand into space, we too must remain committed to new advancements, lest we fall behind. In that regard, it may be significant to note that, of today's major spacefaring powers only Russia and China have spacecraft - Soyuz and Shenzhou - that are capable of returning crews from a trip to the Moon.

UQ—Leadership Declining—China

China is looking forward to exploring the moon

Heng 7/14 (Li Heng, staff writer CNS News “Father of Chang'e I: Chinese on the moon by 2030.” 2011-07-14, <http://www.ecns.cn/cns-wire/2011/07-14/733.shtml> )

Hong Kong (CNS)--Academician Dr. Ye Peijian, expert of Chinese moon exploration projects and the general commander and designer of the Chang'e I satellite, predicted a Chinese manned moon landing by 2030, on July 13.

During a speech at the Hong Kong Polytechnic University (HKPU), he discussed the UN Moon Treaty’s principal of "who arrives first has the right to exploit." "We have to take prompt actions ahead of others, with all conditions matured," said Dr. Ye."As a huge nation of outstanding wisdom, we Chinese can't postpone the moon landing schedule until after 2030." India has already announced their plan to reach the same goal by 2020, and even later advanced the date to 2018. In Dr. Ye's view, India is not capable of this by itself. However, with support from other countries, this is not a daydream. "India's ambition lies in reaching the goal ahead of us. They intend to take over our influence in Asia."As Dr. Ye assessed, 50 years of airspace research and practice has given China matured techniques, facilities, and human resources. Besides, the growing national economy continues to help this cause. Dr. Ye also gave special thanks to the regions of Hong Kong and Macao in their constant support and anticipated HKPU's continuous contributions.China's space station will be built in 2020, with various technical breakthroughs expected. The long time survival, daily necessities, and landing problems of the astronauts are to be dealt with, which are basically all the criteria for a manned moon landing program, said Dr. Ye.

With regards to the Mars plan, Dr. Ye awaits an opportunity for China. Mars and the Earth "meet" every 26 months. This year sees the two planets closest in distance. Calculating this, Dr. Ye would like to see a Mars exploration project carried out in 2013. Considering the current progress being made, it is likely to be rearranged by 2015 at the latest.

Space k2 Leadership

The US needs to be a space leader

Griffin, 2005 (Micheal Griffin NASA Administrator, National Aeronautics and Space Administration, NASA team leader for US Vision for Space Exploaration, Fellow of ASS and AIAA, Leadership in Space, 12/6/05, <http://www.freerepublic.com/focus/f-news/1537483/posts>)

I'm here today to talk about national and world leadership in space - what it means to me, and what I think it takes to achieve and maintain it. I'm certain that most of us here will agree that it is important for the United States to be a leader among the nations of the world, and that such leadership has many dimensions. Economic, cultural, diplomatic, moral and educational leadership are certainly major components of world leadership, and clearly we still live in a time when any wealthy and prominent nation must have the ability to defend itself and its allies. But true leadership also involves defining, and then pursuing, the frontiers that expand mankind's reach. It means occupying the cutting edge of science and technology. It means establishing world technical standards - as we have done in the computing and aviation industries - not through coercion but because we have developed a capability that others wish to use. It also means having the ability and determination to take the lead in building coalitions and partnerships to do those things that fulfill the dreams of mankind. And those dreams have always included the desire to see what lies beyond the known world.

To journey beyond the known world today, we must leave Earth entirely. That is the long-held dream that has actively engaged our country and others for nearly 50 years, since our first primitive steps in the exploration of space became possible. And I firmly believe that in the 21st Century world that is taking shape as we speak, a vital part of world leadership will be leadership in the exploration and development of the space frontier.

For many years, our country has been rightly recognized as the world leader in the exploration and use of space, and in developing and deploying the technologies that make space leadership possible. Our determination to be first on the Moon and preeminent in other space activities resulted in some of the iconic moments of the 20th Century, and helped to solidify American leadership in the generation after World War II.

Space k2 Leadership

US Space exploration key to maintaining global leadership

Griffin, 2005 (Micheal Griffin NASA Administrator, National Aeronautics and Space Administration, NASA team leader for US Vision for Space Exploaration, Fellow of ASS and AIAA, Leadership in Space, 12/6/05, <http://www.freerepublic.com/focus/f-news/1537483/posts>)

Still another key requirement for long-term leadership in space is the ability to build and maintain a strong international coalition of spacefaring nations. A critical component of this ability will always be our credibility in making agreements, and honoring them. In any partnership, the most critical commitments fall upon the senior partner. Since that, of course, is the role we wish to play, we must be thoughtful, deliberate and sure about any commitments we make. But once made, we need to keep them. I think we can all agree that one of the best results of the International Space Station program is the cooperation it has fostered among the participating nations. A prime goal of the President's Vision for Space Exploration is to continue and expand this cooperation as we plan for human lunar return. These are some of the key things we need to do if we Americans are indeed serious about being a leader on the space frontier. As we lift our eyes to the future, I see a space program that will bring hope, opportunity, and tangible benefits as we renew our commitment to lead in these endeavors. While we cannot predict today at what pace others will venture beyond Earth orbit and establish the first outposts on distant worlds, I earnestly believe those nations that are the most adept at reading the lessons of history will be taking the lead. I have mused often upon these lessons, looking for the patterns that can provide guidance for our own time. Indeed, if we were alive 500 years ago, or thereabouts, and a candlelight conference were held in Lisbon by the Portuguese Oceans Authority, no doubt we would be listening to such giants of exploration as Vasco da Gama and Pedro Alvares Cabral, the explorer who claimed Brazil for Portugal, explain how their activities would bring about Portugal's rise to global influence. Perhaps all of us would be speaking Portuguese today had not first Spain, and then later England, made a greater commitment to the discovery, exploration, and settlement of new territories. As an example of how the choices that nations make matter, not only for themselves, but also for the future of humanity, let us consider the case of John Cabot. Cabot, whose true name was Giovanni Caboto, was an Italian who sailed for the English government and with private merchants, after Spain and Portugal expressed no interest in his ideas on finding a westward passage to Asia. While exploring the coastal regions of North American in Newfoundland, he established the basis for England's claim to North America, and was the first to bring our language to the shores we now live. There are more recent examples of similar pivotal crossroads in our history. While American ingenuity, in the form of those quintessentially American inventors, Wilbur and Orville Wright, did lead the way into the era of powered flight, we tend to forget that we squandered our initial leadership in aviation. And so, ninety years ago, the National Advisory Committee for Aeronautics, NASA's major predecessor, was founded precisely because our nation's leaders feared the European nations already had a significant advantage in the development of strategically important aviation systems and technologies, just one decade into the age of flight. This was in fact true, and as a consequence, the air war of World War I was fought with European airplanes. But because we made a strong commitment at that time to this emerging field, the influence of American air power and aviation technology can, today, be seen in everything from the fact that we live in a world not dominated by fascism or communism, to the fact that when you fly anywhere in the world, say from Bangalore to Bangkok, the International Civil Aviation Organization dictates that pilots and air traffic controllers speak English. This is a lesson that cannot be learned too thoroughly: if we become complacent, other nations can and will surpass our achievements. As we look forward to the events that will define the 21st Century, as viewed by the historians of yet future centuries, there is no doubt that the expansion of human civilization into space will be among the great achievements of this era. We have the opportunity, and I would say the obligation, to lead this enterprise, to explore worlds beyond our own, and to help shape the destiny of this world for centuries to come. I am convinced that leadership in the world of the 21st Century and beyond will go to the nation that seeks to fulfill the dreams of mankind. We know what motivates those dreams. Exploring new territory when it becomes possible to do so has defined human striving ever since our remote ancestors migrated out of the east African plains. The human imperative to explore new territories, and to exploit the resources of these territories, will surely be satisfied, by others if not by us. What the United States gains from a robust, focused program of human and robotic space exploration is the opportunity to define the course along which this human imperative will carry us. The Vision for Space Exploration affords the United States nothing less than the opportunity to take the lead, not only in this century but in the centuries to follow, in advancing those interests of our nation that are very much in harmony with the interests of people throughout the world. Space will be explored and exploited by humans. The question is: which humans, from where, and what language will they speak? It is my goal that Americans will be always among them. If this is the future we wish to see, we have a lot of work to do to sustain the Vision which takes us there. To me, the choice could not be more compelling. I thank you for your hospitality today, and again extend my hertfelt thanks to all of you for your commitment to regaining the sense of initiative that has driven our past successes.

Space k2 Economy

The Space Program has helped the economy through economy stimulation

Kimberly Krautter, Why Go to the Moon? It’s Space Between Our Ears, Juky 20, 2009, Ms. Krautter has been a strategic communications consultant to Fortune 500 and emerging industry companies as well as a freelance journalist published in business magazines in the U.S., U.K. and France. http://www.huffingtonpost.com/kimberly-krautter/why-go-to-the-moon-its-th\_b\_240850.html?ref=email\_share

The quest for space exploration today, given the enormous problems on terra firma and an economy that teeters on the brink can seem like a vanity play and a waste of precious time and money. On the surface, that argument seems to hold water. So, let's talk about the money. Did you know that less than one penny of every tax dollar goes to fund the ENTIRE space program? It represents 0.8% of the U.S. budget. That includes monies for cutting edge work by physicists, mathematicians, chemists, biologists, engineers, programmers and more at universities across the nation. What do we get for those pennies? You wouldn't be reading this on the Huffington Post without it. You cannot turn on your TV, radio, speak on the phone, play a video game or even cook food or drive a car without reaping direct rewards of the space program. Yesterday, I found a marvelous list of [space program spinoffs](http://www.thespaceplace.com/nasa/spinoffs.html), and not just in computer-related technologies. Spending money with NASA stimulates every sector of our economy: Consumer/Home/Recreation, Environmental and Resource Management, Health and Medicine, Industrial Productivity and Manufacturing, even Public Safety and Transportation. Even as a diehard NASA-nut, I was amused and excited by this list.Or consider this: Every NASDAQ company is a progeny of the space program.

It's easy to justify much of the space program, but the big open question that remains is manned space flight: sending people up there. It takes a whole lot more technology to support and return people bouncing about the heavens than it does a few tinker toys.

Questioning whether man should continue to go into space is like questioning whether it was worth braving the seas after Magellan circumnavigated the globe. Gee ... what was the return on investment of those programs? Can you say ... America?

To fail to continue to send people into space, to fail to go to the Moon or Mars or beyond, not for the sake of going to kick up some dust but to actually learn about those environments and how they relate to our own sustainability, would be to shrink our horizons and become more pedestrian and self-absorbed than we already are.

Space k2 Competitiveness

Going to the Moon Offers Opportunity for Research and Education

Garan ‘10 (Ron Garan, NASA astronaut. “The Importance of Returning to the Moon” 3/30/2010, <http://www.universetoday.com/61256/astronaut-explains-why-we-should-return-to-the-moon/>)

Great nations accomplish extraordinary endeavors that help to maintain their leadership in the world. America’s history is built on a desire to open new frontiers and to seek new discoveries. NASA’s vision for space exploration acknowledges that, “Mankind is drawn to the heavens for the same reason we were once drawn into unknown lands and across the open [sea](http://www.universetoday.com/62841/sea-photos/). We choose to explore space because doing so improves our lives and lifts our national spirit.” Establishing a lunar infrastructure will challenge us to improve the reliability of space transportation and allow us to demonstrate exploration systems and concepts without leaving the relative safety of near-Earth space. Testing systems and concepts at a location that’s a three-day journey from Earth is a logical step before we make the leap of a six-month journey to Mars. Establishing a permanently occupied lunar base also will open the way to detailed study and use of lunar resources, which likely are significantly more economical than lifting all required exploration resources from the Earth’s surface. The moon offers an incredible opportunity to further human understanding and discovery. Since the moon’s ancient surface is relatively undisturbed, study of its geology can help us better understand the geological history of Earth. Further, the moon’s vacuum environment can’t be duplicated on the Earth or in low-Earth [orbit](http://www.universetoday.com/34665/orbit/), and could lead to new materials, advanced alloys, medicines and innovative ways to deal with limited resources on Earth. Radio telescopes on the far side of the moon would be shielded from all radio signals (noise pollution) from Earth, allowing tremendous sensitivity increases and telescopes pointed at the Earth could identify and predict weather and climate changes. If we return to the moon just for science and exploration then activities will be limited by the amount of money our nation is willing to devote. But, if we establish a sustainable, economically viable lunar base then our science and exploration will be limited only by our imagination. Our children are our best investment for the future, and our space program is a tremendous motivator. Our Nation has seen a steady decline in the number of students studying math and science. The space program can help turn this trend around. I can personally attest to the ability of the space program to encourage students based on the fact that I enrolled in math and science courses and began the pursuit of an engineering degree the day after the first space shuttle mission landed. The creation of a permanent lunar base will inspire millions of young people toward higher education and help maintain our Nation’s technological leadership.

Space k2 Competitiveness

Space exploration encourages youth to pursue careers in STEM professions, this is key to US competiveness and provides for a better future.

Hairston 06 ( John M. Hairston Jr., NASA assistant administrator for education (Human Space Exploration for All)

A CSIS-UNESCO Workshop ▪ October 4, 2006 {Space Agency Education Objectives and Space Exploration Content})

John M. Hairston Jr., NASA assistant administrator for education Human Space Exploration for All (acting), said the fundamental driver for NASA’s education activities is the need for science, technology, and engineering (ST&E) graduates in the United States. He said the U.S. ST&E workforce is declining, and the trend for enrollment in ST&E undergraduate and graduate studies is downward. To meet these challenges, NASA has developed an education portfolio strategic framework to work with the academic community to prepare the next generation of explorers and innovators. The framework highlights agency content, people, and facilities as the foundation for sponsored educational opportunities, while developing new nontraditional partnerships. It identifies three priorities for NASA to work with academia, industry, and informal educators to foster increased studies in science, technology,engineering, and mathematics in order to strengthen the nation’s workforce, attract and retain students, and promote engagementin NASA’s missions. NASA has developed a large number of human space exploration education materials and resources, and Mr. Hairston provided workshop participants with a list of those that have been successfully used by educators and students and proven to be easily replicable. He highlighted NASA’s Reduced Gravity Flight Program, which provides extended term educational/research experience for teams of students, including experiments in microgravity conditions on aircraft. Another successful NASA program is Explorer Schools, which establishes a three-year partnership between NASA and school teams to provide students and educators with tools, experiences, and opportunities to further their education in science, technology, engineering, and mathematics via unique NASA expertise and resources. Mr. Hairston noted that this program has been replicated in the Netherlands. The Delta Researcher Schools project uses the excitement of human spaceflight, the International Space Station, and other international projects to inspire students’ interest in science, technology, engineering, and mathematics. Marilyn Steinberg, program manager of the CSA Space Awareness and Learning Program, said the mandate of their program is to “increase scientific literacy of students and educators such that the students are inspired and both students and educators are equipped to undertake careers in science and technology in Canada.” CSA has over 20 human space exploration education products and resources related to the following themes: Living and working in a closed environment; radiation; International Piero Messina, of the ESA Exploration Program, presented ESA’s Human Exploration Program education products. ESA has developed International Space Station (ISS) education kits for primary and secondary schools. The ISS education kit for primaryschools explains various aspects of life in space and what it is like to live and work onboard the ISS. The kit contains background information, worksheets, color posters, and teacher’s guides. It is currently available in English and will be available in all ESA languages by next year. The kit for secondary schools covers various aspects of the ISS, including what it is, how it is being built, what it’s like to live and work onboard, and what future voyages will be like. In addition to text and explanations about the ISS, the kit contains related interdisciplinary exercises, a teacher’s guide, and presentation materials. It is available in all 12 ESA languages. ESA is also producing DVD lessons, a series of 20-minute lessons that include unique experiments performed by astronauts in space, to explain basic science concepts fitting the European curricula to pupils aged 12 to 18. DVD lessons have been developed on Newton’s Laws of Motion, human physiology, and chemistry; a fourth DVD on robotics will be completed next year. Each DVD is in all 12 ESA languages and includes a teacher’s guide with suggestions for related classroom experiments and activities. ESA has also developed an ISS 3-D game that combines space/ISS simulations with computer games and topics of European curricula. It is available in all 12 ESA languages and includes a teacher’s guide. “Space Academy,” a 3-D education tool that will provide teachers with a pedagogical tool including computer-based exercises related to the European curricula (and to space) for pupils aged 12 to 15, will be available in all 12 ESA languages next year. Eijiro Hirohama, senior adviser to the director, and Takemi Chiku, associate senior administrator, JAXA Space Education Office, described JAXA’s approach to developing space education materials. Their goal is to “help young people acquire insights and develop their own visions” by sharing “the excitement of solving the mysteries of the universe and learning more about achievements in space activities.” JAXA space education objectives are to assist in the maturation of children using space materials so that they understand the links among space, nature, people, and society, as well as science and technology. Through their activities, JAXA aims to promote understanding of the thinking process behind the knowledge, increase appreciation of science and technology, and promote an understanding of the importance of contributing to building a better future. JAXA develops education materials, publications, videos, and CD-ROMs for teachers. Ms. Chiku highlighted JAXA’s introductory education materials on space activities. She said they were developed for use at the beginning of a teaching unit of the existing curriculum in order to stimulate students’ interest in the subjects to be taught in the unit. She highlighted an example of how they use space materials in a homemaking course on learning about “living,” “eating,” and “housing.” The introductory materials use photographs from space that trace the evolution of food that astronauts have eaten in space from Mercury to the International Space Station today to stimulate the interest of students in this subject.

Space k2 Competitiveness

**Maintaining competitiveness in space is key to US hegemony and economy**

Whitesides 08 (George T. Whitesides executive director national space society before the subcommittee on space, aeronautics, and related sciences, Senate Hearing on “Reauthorizing the Vision for Space Exploration” May 7, 2008 Chairman Nelson, Ranking Member Vitter, and members of the subcommittee. <http://www.spaceref.com/news/viewsr.html?pid=27921> )

“We cannot outsource our manned space flight needs to other countries if we are to be a world leader.”

Perhaps the most urgent space issue our nation faces in the next few years is the human spaceflight gap between the retirement of the Space Shuttle and the start of Constellation Program operations. This gap, right now estimated to be five and a half years, will be about as long as the gap the nation experienced between the retirement of the Apollo hardware and the launch of the Space Shuttle. Our nation’s space program survived that gap, but the environment was much different then. Where we once had a single competitor in space, we now have several. Where before we faced competition in orbital operations rather than lunar adventures, today there are three other nations orbiting hardware around the Moon, with Russia and China both expressing interest in sending humans there, possibly before Constellation’s target date of 2020. We are running the risk of falling behind in space, even if no “space race” has been declared.

The consequences of the gap, as seen during the transition between Apollo and Shuttle, are well known and ominous. Loss of funding translates into a loss of NASA’s most critical assets: the knowledge, corporate memory, and hands-on skills of its people. With a loss of jobs comes a loss of economic vitality in communities like Brevard County, Florida, and New Orleans, Louisiana, as people move away to look for jobs and take their money and families with them. Once those people are gone, restoring diminished capabilities and communities will not be as simple as issuing a call-back after a brief layoff.

Jerry Carr, Commander of the final Skylab flight – a man who knows about such issues firsthand – wrote me the following comments: “I thought that we had learned the lesson during the seven-year hiatus between the Apollo and Shuttle programs. A huge body of NASA and contractor skill and experience just left to do something else. Then the workforce had to be built up all over again at no mean cost in order to proceed with the Shuttle and Space Station programs.

“Where is the incentive to build up our scientific and technical base if we have no space program to which those young minds can aspire? Space exploration is where the United States has shown leadership, and in the current climate … we can't afford to abdicate the heritage we have established in space.”

Over 20 years ago, a prescient report came out following the Challenger accident, The Report of the National Commission on Space. It made a similar observation then, and today the situation is significantly more pressing:

“Should the United States choose not to undertake achievement of these economies in launch and recovery capability, then the Nation must face the probability that other nations will rapidly overtake our position as the world’s leading spacefaring nation. The competition to get into space and to operate effectively there is real. Above all, it is imperative that the United States maintain a continuous capability to put both humans and cargo into orbit; never again should the country experience the hiatus we endured from 1975 to 1981, when we were unable to launch astronauts into space.”

NASA k2 Competitiveness

New NASA programs are essential to public support and engage citizens in education

Whitesides 08 (George T. Whitesides executive director national space society before the subcommittee on space, aeronautics, and related sciences, Senate Hearing on “Reauthorizing the Vision for Space Exploration” May 7, 2008 Chairman Nelson, Ranking Member Vitter, and members of the subcommittee. <http://www.spaceref.com/news/viewsr.html?pid=27921> )

All of these activities enable private citizens, especially our young people and students, to learn, develop, and be rewarded for new technologies.

As a tactical and practical matter, NASA must integrate public participation meaningfully at the initial design phases of its missions. This means using the tools of the Internet as means of allowing private citizens access and input into future exploration missions. This goes beyond the simple distribution of images via the Web, to an era in which the public truly experiences space exploration, in real-time and in high resolution. Participatory exploration offers the opportunity for NASA and other space organizations to redefine the public’s relationship with exploration, and energize the public about space exploration goals and missions.

Ames Research Center’s open forum in the “Second Life” web-based graphical environment, known as Co-Lab, provides one such model for participation. Private citizens are allowed to join in discussions about goals and experiments being developed for robotic exploration of other worlds.

OpenNASA.com has become a sounding board for NASA’s Generation Y employees to share their experiences and thoughts about how to improve the agency at a technological and cultural level. To encourage future interest and mass participation in future missions, NASA could incorporate Webbased interactivity into robotic landers from the start. For example, viewers could vote on where a rover might travel to next, where to place the American flag on a future human mission to the Moon or Mars, or what to name particular features of a landing site. All of these methods are electronic means of attracting and holding the attention of a generation that has grown up with the Internet and expects interactivity—in technologies as well as organizations.

It might seem paradoxical, but while support for NASA remains consistently high, the public often has little specific knowledge of the benefits they receive from the agency’s activities. NASA’s human exploration missions can be used to address most of the major issues threatening our uncertain world, from energy independence, to economic, national, and environmental security. In other words, the space program can help address issues Americans are concerned about most.

Competitiveness k2 Economy

US economy collapses when competiveness suffers

Luigi Zingales**,** Professor of Entrepreneurship and Finance, Chicago University (2002) University of Chicago, NBER, & CEPR, Is The U.S. Capital Market Losing Its Competitive Edge? (The Journal of Economic Perspective) Lang et al. (2002) estimate

we can estimate that there will be 198 fewer analysts employed following these stocks. 22 the U.S. equity markets cannot be ignored. It is a sign that the U.S. equity markets have become less competitive and something should be done before the economy will suffer the consequences. But what can be done? We cannot alter the attractiveness of our competitors, but we can definitely work to make the U.S. equity market more attractive. When the competitive advantage of the U.S. equity market was very large, no regulation, not matter how expensive, could discourage companies from listing here. But today, this is not true any more. To make the U.S. capital market more competitive we need more costeffective regulation. This does not necessarily mean less regulation. One of the reasons why listing in the United States carried a premium (at least until few years ago) is because investors appreciated the degree of bonding offered by U.S. institutions. This bonding, however, has costs as well. Regulation needs to trade off these costs and benefits.

Space Exploration Good/AT: DAs

The Benefits of Space Exploration far outweigh that of the Negs case disads

Rep. Ralph Hall, “Numerous benefits of space expoloration” 07/14/09 is ranking member of the House Science and Technology Committee.  
Anyone who follows NASA knows that President Obama recently launched an independent review of planned U.S. human spaceflight activities. The blue ribbon panel, headed by Norman Augustine, retired chairman and chief executive officer of Lockheed Martin, and my friend, is expected to release its findings in August. I am confident that Norm will not sugarcoat the panel’s findings, and I am also optimistic that the panel will promote an ambitious goal for manned space exploration. America’s space and technological preeminence in the world hangs in the balance.its 40-year history, our space program has set goals that required innovation and technology yet to be developed, and the results have been astonishing. Miniaturized integrated circuits, satellite technology, GPS navigation systems, bone-density measurements, miniaturized heart pumps and other technologies derived from NASA research and development have saved and improved our lives. New spin-offs include water filtration systems that turn wastewater into drinkable water, wireless light switches, remediation solutions for sites contaminated by chemicals, the development of Liquidmetal and sensors on reconnaissance robots used in Afghanistan and Iraq to deal with improvised explosive devices. The list goes on and on.The National Research Council recently released a report advocating that NASA align its civil space program with national needs. While I understand the temptation to focus on finding solutions to present problems, we need to remember that much of the R&D conducted by NASA has resulted in unintended yet beneficial breakthroughs. Space exploration drives innovation by reaching into the unknown and overcoming complex problems. This sort of problem-solving inherently pushes the limits of technology. Space exploration fundamentally necessitates basic research. If we try to task NASA with too narrow a mission for R&D, we lose the possibility of new discoveries and breakthroughs to adapt technologies in new and creative ways that could have unanticipated applications.Rather than micromanage the type of research we want from our space program, I would prefer a clear goal for U.S. space exploration. NASA must have a challenging, inspirational goal that is ambitious and sufficiently funded.  President Bush gave NASA the direction it needed with his Vision for Space Exploration, which included a plan to complete the International Space Station (ISS), retire the Space Shuttle, and develop a new launch system capable of traveling outside low Earth orbit, with a goal of returning to the moon by 2020 as a stepping stone to more difficult destinations such as Mars. This was a goal that Congress endorsed in the NASA Authorization Act of both 2005 and 2008, which were subsequently signed into law. Our space program has accomplished many great feats in the last half-century and it is only prudent to implement and fund a vision that builds on that progress.America and our global partners have nearly completed the ISS, which is possibly the most elaborate engineering endeavor of all time. Unfortunately, with an impending five-year gap in U.S. spaceflight capability following retirement of the Space Shuttle, we will have to rely on Russia and our international partners to ferry crew and cargo to and from the ISS. This is a setback for our space program but one that can be overcome with a renewed commitment to space exploration.I strongly believe that we must close the gap in U.S. access to space and it is my hope that the Augustine panel comes to a similar conclusion. NASA has made great progress in developing the Orion vehicle and the Ares launch systems. Constellation is already in the development phase, so to abandon this plan now would be a massive waste of time, money and resources.The one-half of one percent of the national budget devoted to NASA may be the best investment we make, providing for long-term, high-dividend research, and technology breakthroughs. Economic growth is driven by technological innovation, and space exploration fuels this innovation.It takes courage, desire, and vision to explore the unknown. And it takes national leadership at all levels. We must not default on our vision for space or permit other nations to take away our position of leadership at the forefront of exploration and research. That leadership translates into economic opportunities, national security, secure manufacturing jobs, and an increased standard of living for all AmericansThis week we are celebrating the 40th anniversary of the Apollo 11 moon landing. When history is written, America will be recognized for one of the most significant technological achievements of the 20th century, and one of the most thought-provoking human triumphs of all time. This audacious feat, witnessed by billions of people around the world, captured the imagination of all Americans and led to unprecedented increases in science and engineering enrollments at our colleges and universities. The example is clear. NASA is one of our best success stories and deserves our enthusiastic support. Now is not the time to reduce our goals or expectations. Now is the time to set the bar higher.

Mining UQ

The moon is livable and has vast natural resources—but other countries like China are already moving to claim it

Don C. Brunell, President of the Association of Washington Business, “Mistake to Bypass the Moon,” 23 April 2010, <http://www.awb.org/articles/competitiveness/mistake_to_bypass_the_moon.htm>

Canceling the Constellation program – the successor to America’s historic space shuttle program—is a huge mistake, but that is exactly what President Obama plans to do. He told folks at the Kennedy Space Center that he is also abandoning returning to the moon. Instead, he plans to send astronauts to asteroids and, eventually, to Mars. Obama wants private companies to take over shuttling astronauts and cargo to the International Space Station, but until that happens, the U.S. would pay $50 million a pop for our astronauts to hitch a ride on Russian spacecraft. In abandoning a lunar program, the president missed the point. It is not about “been there, done that;” it is about having a place from which to launch deep space missions — like his mission to Mars.T— test new technologies and develop limitless supplies of clean energy the moon is a valuable resource just waiting to be developed by some enterprising nation.Space physicist David Criswell believes it could supply clean renewable energy for our entire planet. He and others envision a series of lunar power facilities to capture massive amounts of solar energy and beam it back to Earth. The moon receives more than 13,000 terawatts of energy and harnessing one percent of that energy could satisfy our planetary needs.Apollo 17 astronaut Dr. Harrison “Jack” Schmitt, a geologist and one of the last two people to walk on the moon, believes Helium 3 found on the moon is the key to the second generation of fusion reactors. A light non-radioactive isotope, Helium 3, is rare on Earth, but plentiful on the moon, and scientists believe it could produce vast amounts of electricity.Potential lunar colonization got a healthy boost a year ago when ice was discovered by NASA scientists at its south pole. That means there could be drinking water, oxygen for breathing and hydrogen for rocket fuel on the moon itself.China sees the strategic advantage of establishing bases the moon and plans to start within 10 years. Ironically, the United States is the clear leader in lunar technology. We have an experienced corps of veteran astronauts, so Obama’s plan makes no sense, economically or scientifically. It is true that the Constellation program has had delays and cost overruns, a particularly thorny issue in today’s troubled economy. But this is complex technology, and squandering the $11 billion already invested in it is a waste. To reach Mars from Earth, Obama’s budget funds the design and production of massive new heavy lift rockets. But because gravity on the moon is one-sixth that of the Earth, wouldn’t it be far easier to launch Mars missions from the moon? China apparently thinks so.While some in the scientific community support Obama’s plan, many high-profile astronauts oppose it. The first and last men on the moon, Neil Armstrong and Eugene Cernan, said Obama's proposal "destines our nation to become one of second- or even third-rate stature." Former astronaut Winston Scott, dean of the college of aeronautics at the Florida Institute of Technology, said, "You can't call yourself a leader if you have to hitch a ride with someone else.'' Encouraging the private sector to provide shuttle transport in the future is a good idea. But that could be a long time coming. American space hero John Glenn proposes that our existing space shuttles should be refurbished and fly at least until the private sector has a proven alternative.Through decades of risk, sacrifice, heroism and hard work, America has led the world in unprecented space exploration. Now, the president’s plan would have the United States step aside as the Russians shuttle to and from the space station and the Chinese pass us on the way to the moon.

Mining UQ

Countries are advancing towards landing on the moon, The U.S must make the first move

James Pinkerton, Jan 14, 2009. “Beam Us Up, Barak!” contributor to the Fox News Channelhttp://newamerica.net/user/120

Space exploration, despite all the bonhomie about scientific and economic benefit for the common good, has always been driven by strategic competition. Beyond mere macho “bragging rights” about being first, countries have understood that controlling the high ground, or the high frontier, is a vital military imperative. So we, as a nation, might further consider the value of space surveillance and missile defense. It’s hard to imagine any permanent peace deal in the Middle East, for example, that does not include, as an additional safeguard, a significant commitment to missile and rocket defense, overseen by impervious space satellites. So if the U.S. and Israel, for example, aren’t there yet, well, they need to get there. Americans, who have often hoped that space would be a demilitarized preserve for peaceful cooperation, need to understand that space, populated by humans and their machines, will be no different from earth, populated by humans and their machines. That is, every virtue, and every evil, that is evident down here will also be evident up there. If there have been, and will continue to be, arms races on earth, then there will be arms races in space. As we have seen, other countries are moving into space in a big way–and they will continue to do so, whether or not the U.S. participates.

China and India are paying close attention to space, tensions on the brink

James Pinkerton, Jan 14, 2009. “Beam Us Up, Barak!” contributor to the Fox News Channelhttp://newamerica.net/user/120.

For their part, the Chinese seem to have absorbed these geostrategic lessons. They are determined now to be big players in space, as a matter of national grand strategy, independent of economic cycles. In 2003, the People’s Republic of China powered its first man into space, becoming only the third country to do so. And then, more ominously, in 2007, China shot down one of their own weather satellites, just to prove that they had robust satellite-killing capacity.Thus the US and all the other space powers are on notice: In any possible war, the Chinese have the capacity to “blind” our satellites. And now they plan to put a man on the moon in the next decade. “The moon landing is an extremely challenging and sophisticated task,” declared Wang Zhaoyao, a spokesman for China’s space program, in September, “and it is also a strategically important technological field.” India, the other emerging Asian superpower, is paying close attention to its rival across the Himalayas. Back in June, The Washington Times ran this thought-provoking headline: “China, India hasten arms race in space/U.S. dominance challenged.” According to the Times report, India, possessor of an extensive civilian satellite program, means to keep up with emerging space threats from China, by any means necessary. Army Chief of Staff Gen. Deepak Kapoor said that his country must “optimize space applications for military purposes,” adding, “the Chinese space program is expanding at an exponentially rapid pace in both offensive and defensive content.” In other words, India, like every other country, must compete–because the dangerous competition is there, like it or not. India and China have fought wars in the past; they obviously see “milspace” as another potential theater of operations. And of course, Japan, Russia, Brazil, and the European Union all have their own space programs.

Mining UQ

Canada looking to mine the moon

ELIZABETH THOMPSON 08 (The Gazette (Montreal), Lexis)

It's a contract that's out of this world. The Canadian Space Agency is taking a first tentative step on a voyage that could lead to mining operations on the moon, calling for an expert to prepare a pre-feasibility study on the potential use of Canadian mining expertise to prepare a future outpost site. The study, expected to take six months, will examine possibilities for setting up basic habitation on the moon and a "utilitarian infrastructure."The St. Hubert-based agency has budgeted up to $120,000 for the lunar mining study and another $120,000 for a second pre-feasibility study on the potential development of lunar surface transportation systems. As nations around the world join forces to pool their resources for space operations, Canada appears to be positioning itself for a role in exploiting the rich mineral resources of the lunar landscape. A Global Exploration Strategy paper jointly prepared in May 2007 by several international space agencies says that entrepreneurs are already eyeing commercial opportunities in space and mining the moon is just one of them."Moon rocks are rich in oxygen that might be exploited to provide life support systems for lunar operations," the authors wrote. "Liquid oxygen can also be used as a rocket propellant - and it might be more economical to manufacture it in space than to lift it off the Earth."Mining the moon might also yield titanium - a strong but light metal favored for high-end aerospace applications," the authors added. "Finally, the moon's known abundance of helium-3 could prove valuable if fusion reactors ever become feasible in the future."Officials from the space agency were reluctant to comment yesterday on the studies, saying only that it is very early in the process and they don't want to risk affecting the bidding process for the contract to carry out the pre-feasibility study. However, in the documents provided for potential bidders on the contract to provide the moon mining study, the space agency says Canada has proven with the space arm that it can make a significant contribution to a major space program. Now it wants to see whether Canada's existing expertise in mining can be transferred to a new frontier. The agency wants the study to look at Canada's existing expertise and how to nhance the chances that Canadian industry is the one to provide a mining platform on the moon. The study should also look at why Canada should get involved in expensive facility construction and why Canada should dedicate resources to research lunar mining and construction of an outpost. While current models being examined by NASA call for the construction of an outpost at one of the moon's South Pole craters and inflatable pressurized shells for astronaut living quarters, the Canadian Space Agency says it wants the pre-feasibility study to explore the option of tele-robotic drills creating a series of mine shafts under the moon's surface and creating "an underground habitat in the mining shafts shielded from the sun and cosmic elements."The program could also have some very down-to-Earth advantages, the agency points out."Canadian Space Agency R&D investments in lunar transport-mining systems may serve as well as an accelerator for technological development of green technology transport-mining vehicles in partnership with existing other government department programs," it wrote. "Such (a) scheme could contribute to position Canada to lead in the foray into green technology transport-mining."

Mining UQ

India and China’s space race—they deny it, but it’s over lunar resources.

Hennock, Kushner, Overdorf, Kashiwagi ’08 (Mary, Adam B., Jason, Akiko, Editors for *Newsweek* “The Real Space Race Is In Asia;

As China tries to catch up to the United States and Russia, its regional neighbors are fast on its heels.,” 09/29/2008, Nexus) DOA: 7/20/2011

China first sent a man into space in 2003, and India won't achieve that goal until 2015, but according to unofficial schedules, China will beat India to a moon landing by only a year. Reaching the moon is the childhood dream of Madhavan Nair, chairman of India's space program, which is now spending about $1 billion per year, compared with an estimated $2.5 billion a year in China. If all goes well, at the end of October India will launch the $100 million Chandrayaan-I, its first lunar orbiter, using the workhorse Polar Satellite Launch Vehicle. The orbiter will fire a probe at the moon's surface, kicking up a cloud of lunar dust that scientists will analyze from afar--and it will plant the Indian flag in lunar soil. Its successor, Chandrayaan-II, a cooperative effort with Russia (and, therefore, one looked down upon by Chinese analysts), is expected to land a rover on the moon by 2012. The space agency, if it can persuade Parliament to fund all its dreams, aims to put a man on the moon by 2020, followed by robotic missions to Mars, a nearby asteroid and the sun--an agenda even more ambitious than China's. The Indian space agency is careful to defend the program as more than an ego competition with the Chinese. It argues that its space program has earned a return of $2 on every dollar invested by the government, according to Nair. For example, its remote sensing satellites, which map the Earth's surface at a resolution of close to one meter, have helped find well water in dry regions, saving the government's drill boring program $100 million. And, while only a few years ago Indian space officials ruled out manned missions as too expensive and of dubious scientific value, they now speak--just like the Chinese--of mapping the moon for deposits of aluminum, silicon, uranium and titanium, probably with an eye to lunar mining. "I don't think we're in any race as far as the space program is concerned," says Nair. "We have our own national priorities, and based on those priorities we try to concentrate on developments which will benefit the people." Moon shots for the masses? "If you ask people [in the space agencies], they will never acknowledge there is a competition," says Pallava Bagla, the author of "Destination Moon," a book about India's moon mission. "But subliminally there is a definite race there." The two sides don't talk about it because, says the Stimson Center's Michael Krepon, "for Beijing, you don't want to put New Delhi on the same playing field. For New Delhi, you don't want to acknowledge anxiety." Krishnaswamy Kasturirangan, a member of Parliament and Nair's predecessor, says that in addition to luring Indian engineers from the high-paying IT divisions into astrophysics, the space program will "establish our credentials in the international community." It makes India a player. The benefits of manned missions for the military are only somewhat clearer. Beijing's satellite shoot-down last year demonstrated the potential vulnerability of objects in space. Its space program--which is ultimately run by the Army--got its start when engineers took military rockets and stuck capsules on the tip. And despite Delhi's claims to the contrary, Western analysts suspect that booster technology developed for India's civilian space program is used by its military arm. But the quick way to strengthen military rockets is to fund them directly, not to fly moon missions. By the same token, ground-based and orbiting lasers would probably make better antisatellite weapons than missiles. "The U.S. military and the Russian military searched for years for good reasons to put military people in space and never found any," says John Logsdon, senior fellow at America's Smithsonian National Air and Space Museum. Still, a space race is a risky way to boost national status: after all, a catastrophic accident while attempting merely to repeat this step for mankind would be a historic humiliation. But the risk is not without rewards. Successful space flight is a kind of national advertisement for satellites and, more broadly, quality control. "[China's] manned space program has gone a long way to proving to potential customers that their products are safe," says Theresa Hitchens of Washington's Center for Defense Information. In these days of global competition, that's a message both China and India desperately want to send.

Mining UQ

Other World Powers Plotting to Mine Moon

Williams, 2007 (Mark Williams, Contributing Editor for the Technology Review. Technology Review, Published by MIT “Mining the Moon”, 8/23/2007 <http://www.technologyreview.com/energy/19296/page1/>)

At the 21st century's start, few would have predicted that by 2007, a second race for the moon would be under way. Yet the signs are that this is now the case. Furthermore, in today's moon race, unlike the one that took place between the United States and the U.S.S.R. in the 1960s, a full roster of 21st-century global powers, including China and India, are competing. Even more surprising is that one reason for much of the interest appears to be plans to mine helium-3--purportedly an ideal fuel for fusion reactors but almost unavailable on Earth--from the moon's surface. NASA's Vision for Space Exploration has U.S. astronauts scheduled to be back on the moon in 2020 and permanently staffing a base there by 2024. While the U.S. space agency has neither announced nor denied any desire to mine helium-3, it has nevertheless placed advocates of mining He3 in influential positions. For its part, Russia claims that the aim of any lunar program of its own--for what it's worth, the rocket corporation [Energia](http://www.energia.ru/english/) recently started blustering, Soviet-style, that it will build a [permanent moon base](http://www.space.com/news/ap_060126_russia_moon.html) by 2015-2020--will be extracting He3. The Chinese, too, apparently believe that helium-3 from the moon can enable fusion plants on Earth. This fall, the People's Republic expects to orbit a satellite around the moon and then land an unmanned vehicle there in 2011. Nor does India intend to be left out. (See "[India's Space Ambitions Soar](http://www.technologyreview.com/Infotech/19115/).") This past spring, its president, A.P.J. Kalam, and its prime minister, Manmohan Singh, made major speeches asserting that, besides constructing giant solar collectors in orbit and on the moon, the world's largest democracy likewise intends to mine He3 from the lunar surface. India's probe, [Chandrayaan-1](http://www.isro.org/chandrayaan/htmls/home.htm), will take off next year, and ISRO, the Indian Space Research Organization, is talking about sending [Chandrayaan-2](http://www.hindu.com/2007/01/04/stories/2007010401342200.htm), a surface rover, in 2010 or 2011. Simultaneously, Japan and Germany are also making noises about launching their own moon missions at around that time, and talking up the possibility of mining He3 and bringing it back to fuel fusion-based nuclear reactors on Earth.

Helium-3 UQ

The world’s supply of helium-3 is dwindling

America's looming helium crisis (no, really)

Washington Post ‘11 (Brad Plumer is a staff writer for The Washington Post) Posted at 03:08 PM ET, 05/31/2011 http://www.washingtonpost.com/blogs/ezra-klein/post/americas-looming-helium-crisis-no-really/2011/05/31/AGZIBdFH\_blog.html

Over the weekend, the New York Times’ Matthew Wald reported that we're running out of helium-3, a rare but useful helium isotope, thanks to a bit of bureaucratic blundering:The United States is running out of a rare gas that is crucial for detecting smuggled nuclear weapons materials because one arm of the Energy Department was selling the gas six times as fast as another arm could accumulate it, and the two sides failed to communicate for years, according to a new Congressional audit.The gas, helium-3, is a byproduct of the nuclear weapons program, but as the number of nuclear weapons has declined, so has the supply of the gas. Yet, as the supply was shrinking, the government was investing more than $200 million to develop detection technology that required helium-3.Now, scientists might be able to invent new weapons detectors, but helium-3 has also been proposed as a fuel for next-generation fusion reactors. Trouble is, there's just not all that much helium-3 to go around. There's plenty of the stuff in the earth's mantle, but it's nearly impossible to retrieve, and manufacturing tritium (which decays into helium-3) is fantastically energy-intensive. Harvesting the gas from decommissioned nuclear weapons was always the most economical approach. One option left would be to mine it from the moon's surface: indeed, Russia and China have both said that helium-3 mining would be a major goal of future lunar explorations.In any case, Wald's story reminded me of our other helium crisis. Back in the 1920s, the United States decided to create a national reserve for plain old helium — this was back when the dirigible seemed like a useful military apparatus — and stockpiled the gas over the course of the 20th century, in a porous rock structure near Armarillo, Tex. But in 1996, Congress was eager to cut government expenses and figured there was no longer any need for a helium reserve, so it decided to sell off all of the spare helium by 2015. (It was not unlike today, when many conservatives are calling on the U.S. government to sell off its assets instead of hiking the debt ceiling.)A small hitch ensued: Congress fixed the price of helium way too low. That's partly why people can afford to fritter away helium on party balloons and Donald Duck imitations. With the pricetag plummeting, private companies had no incentive to seek out new sources. And, as a result, the country may run out of helium in short order. That's troubling, because helium is actually very useful: The superconducting magnets in MRI machines require helium, as do certain manufacturing processes for LCD screens and optical fibers. The Large Hadron Collider would overheat without a healthy supply of liquid helium. And much of our helium, artificially cheap, is getting wasted on clown balloons, eventually leaking into the air where it can't be recovered.Robert Richardson, a physicist and Nobel laureate at Cornell, has been warning about our helium doomsday for years, noting that at current usage rates, "the world would run out in 25 years." With luck, that won't happen. Congress could always change its reserve policy and align its pricing with the market. Or new U.S. reserves could conceivably be found, extracted from natural-gas fields. Still, it's a potential problem (even if not the gravest crisis facing the country). And it's a reminder that a fire sale of government assets — an idea that's floating up right now — isn't always so cost-free.

Helium-3 Good: General

Helium-3 is a Safe and Working Alternate for Fossil Fuels and Plentiful on the Moon.

Lasker 2006, (John, December 15, who is quoting Gerald Kulcinski, a professor who leads the Fusion Technology Institute at the University of Wisconsin. “Race to the Moon for Nuclear Fuel” <http://www.wired.com/science/space/news/2006/12/72276> DOA: July 20, 2011)

NASA's planned moon base announced last week could pave the way for deeper space exploration to Mars, but one of the biggest beneficiaries may be the terrestrial energy industry. Nestled among the agency's 200-point mission goals is a proposal to mine the moon for fuel used in fusion reactors -- futuristic power plants that have been demonstrated in proof-of-concept but are likely decades away from commercial deployment. Helium-3 is considered a safe, environmentally friendly fuel candidate for these generators, and while it is scarce on Earth it is plentiful on the moon. As a result, scientists have begun to considerthe practicality of mining lunar Helium-3 as a replacement for fossil fuels. "After four-and-half-billion years, there should be large amounts of helium-3 on the moon," said Gerald Kulcinski, a professor who leadsthe Fusion Technology Institute at the University of Wisconsin at Madison. Last year NASA administrator Mike Griffin named Kulcinski to lead a number of committees reporting to NASA's influential NASA Advisory Council, its preeminent civilian leadership arm. The Council is chaired by Apollo 17 astronaut Harrison Hagan "Jack" Schmitt, a leading proponent of mining the moon for helium 3. Schmitt, who holds the distance record for driving a NASA rover on the moon (22 miles through the Taurus-Littrow valley), is also a former U.S. senator (R-New Mexico). The Council was restructured last year with a new mission: implementing President Bush's "Vision for Space Exploration," which targets Mars as its ultimate destination. Other prominent members of the Council include ex-astronaut Neil Armstrong. Schmitt and Kulcinski are longtime friends and academic partners, and are known as helium-3 fusion's biggest promoters. At the Fusion Technology Institute, Kulcinski's team has produced small-scale helium-3 fusion reactions in the basketball-sized fusion device. The reactor produced one milliwatt of power on a continuous basis. While still theoretical, nuclear fusion is touted as a safer, more sustainable way to generate nuclear energy: Fusion plants produce much less radioactive waste, especially if powered by helium-3. But experts say commercial-sized fusion reactors are at least 50 years away. The isotope is extremely rare on Earth but abundant on the moon. Some experts estimate there are millions of tons in lunar soil -- and that a single Space-Shuttle load would power the entire United States for a year. NASA plans to have a permanent moon base by 2024, but America is not the only nation with plans for a moon base. China, India, the European Space Agency, and at least one Russian corporation, Energia, have visions of building manned lunar bases post-2020.Mining the moon for helium-3 has been discussed widely in space circles and international space conferences. Both China and Russia have stated their nations' interest in helium-3. "We will provide the most reliable report on helium-3 to mankind," Ouyang Ziyuan, the chief scientist of China's lunar program, told a Chinese newspaper. "Whoever first conquers the moon will benefit first."

Helium-3 Good: Energy

Mining on the moon is provides the US with a powerful source of energy

Thompson (Elizabeth, “Canada looks to the moon; Space agency study. Rich mineral resources are the target”, LexisNexis,

"Moon rocks are rich in oxygen that might be exploited to provide life support systems for lunar operations," the authors wrote. "Liquid oxygen can also be used as a rocket propellant - and it might be more economical to manufacture it in space than to lift it off the Earth."Mining the moon might also yield titanium - a strong but light metal favored for high-end aerospace applications," the authors added. "Finally, the moon's known abundance of helium-3 could prove valuable if fusion reactors ever become feasible in the future."Officials from the space agency were reluctant to comment yesterday on the studies, saying only that it is very early in the process and they don't want to risk affecting the bidding process for the contract to carry out the pre-feasibility study.

Helium-3 Good: Fusion

Lunar Mining Solves Fossil Fuel Shortage

Hedman, 2006 (Eric Hedman, chief technology officer of Logic Design Corporation, “A fascinating hour with Gerald Kulcinski”, The Space Review, 1/16/2006, http://www.thespacereview.com/article/536/1)

Fusion power can replace fossil fuels all together but only Helium-3 Fusion is cost effective. Moon mining is the first step needed to make fusion viable

Helium-3 fusion. After our discussion on what it takes to inspire young people to enter technical fields our conversation drifted back to my original reason for wanting the interview, nuclear fusion using helium-3. Most nuclear fusion research is on reactors that use a deuterium-tritium fuel cycle. Helium-3 is not used anywhere else because the supply on Earth is so very limited. The limited supply on Earth is what makes the connection between Professor Kulcinski and NASA so very intriguing. Imagine a world thirty years from now. NASA has led the way to returning humans to the Moon and is in the final steps of preparing for human exploration and settlement of Mars. On Earth our environment is cleaner with reliable fusion reactors steadily replacing coal-fired plants and fission reactors. The fuel for these reactors is being mined from the surface of the Moon relegating the mercury, radium and carbon dioxide-laced exhaust from coal-fired plants to “the ash heap of history”. The growth of highly radioactive waste from fission power plants is following coal into history. Dependency on highly volatile regions of our planet for energy supplies is steadily diminishing. Clean power is allowing economic development of the world to continue, lifting a higher and higher percentage of the population out of poverty. Is this a possible future for our country and the planet? Professor Kulcinski and his small team of researchers just might have the answer and NASA might provide access to the key enabling resource. The deuterium-tritium fuel cycle has some inherent problems that might be extremely difficult to overcome. A deuterium-tritium fuel cycle releases eighty percent of its energy in a stream of high-energy neutrons. These neutrons are highly destructive to anything they strike, including the containment vessel. Tritium is a highly radioactive isotope of hydrogen that is hard to contain with the risk of release. Radiation damage to structures may weaken them and leave highly radioactive waste behind as components need to be replaced and when reactors are decommissioned. It wasn’t long after the development of the atom bomb that development work on thermonuclear weapons—the hydrogen bomb—was started. Physicists already knew that fusion as a power source was theoretically possible. It wasn’t until the seventies, though, that scientists started trying to develop the technology to do it. A roadmap was laid out to try to get it to work. Thirty years later we’re still thirty years away from commercially-viable fusion reactors based on current development plans. Twenty years ago almost to the day of my meeting with Professor Kulcinski, he and a group of scientists met at a retreat south of Madison, Wisconsin to discuss the problems with the deuterium-tritium fuel cycle for fusion. They talked over what the options are for a better fuel. Helium-3 is what they came up with. The only problem is that there are only a few hundred kilograms of it on Earth. In their brainstorming they knew that helium-3 was an intermediate product of the fusion reactions in the Sun. Significant quantities of it are released in solar wind. Earth’s magnetic field diverts charged particles around the planet protecting us from life-threatening radioactive sunburns. The Moon, however, does not have such protection. It has been bombarded with solar wind for billions of years. One of the scientists, Dr. John Santarius, did some quick calculations and determined that it has been hit with approximately 500 million metric tons over the eons. Forty metric tons of helium-3 is the energy equivalent of all the power pumped into the US power grid in 2005. The next key question was how much is still there. In January of 1986 Professor Kulcinski and his group contacted the Lunar and Planetary Institute at the Johnson Space Center. The soil samples from the Apollo missions are stored there. Every sample from the Moon had helium-3 in it. It didn’t matter if the sample was collected from right on the surface or from a core sample a meter deep, the maximum depth core samples were collected from. What makes this interesting is that a helium-3 atom will stop within a few angstroms of hitting the soil. So why is it found in samples taken a meter deep? The Moon has been pulverized over the years by meteors that have tilled the soil, overturning it and rearranging the surface. After examining the samples scientists determined that there are approximately a million metric tons of helium-3 on the Moon. This leads to the question of how do you cost-effectively get it. It is also a good reason why it’s important to study how the Moon and other planets formed, and how they have interacted with the environment since then. Helium-3 and other useful gasses are easily released from lunar soil when heated to 700 degrees Centigrade. You then cool the gas until everything except the helium-3 condenses out. The helium-3 can then be separated from the more-common helium-4 by well-known techniques. You bottle the remaining gas and ship it back to Earth. The University of Wisconsin is working on a design of an automated lunar miner to rove across the surface of the Moon to extract helium-3 and life-support volatiles. NASA’s vision for exploration provides potential access to get sufficient quantities of helium-3. If sufficient supplies of helium-3 are available, the next issue is how to get fusion to work using it.

Helium-3 Good: Radiation Detection

Helium-3 is critical in detecting tracing radiation of nuclear material. Shortages make it almost impossible to detect smuggled nuclear weapons.

Dixon 2010, (Darius, April 29, “Helium-3 Shortage Could Mean Nuke Detection ‘Disaster’ DOA: July 18, 2011

http://www.wired.com/dangerroom/2010/04/helium-3-shortage-could-mean-nuke-detection-disaster/#more-24154)

Stopping nuclear smuggling is already tough. But it’s about to get a lot harder. Helium-3, a crucial ingredient in neutron-particle-detection technology, is in extremely short supply. Rep. Brad Miller (D-North Carolina), chairman of the House Subcommittee on Investigations and Oversight, chided the Departments of Energy and Homeland Security at a hearing on the issue late last week, suggesting that they created a preventable “disaster.” The Energy Department is the sole American supplier of helium-3, and DHS is supposed to take the lead in spotting and stopping illicit nuclear material. The helium-3 isotope represents less than 0.0002 percent of all helium. Of that, about 80 percent of helium-3 usage is devoted to security purposes, because the gas is extremely sensitive to neutrons, like those emitted spontaneously by plutonium. Helium-3 is a decay product of tritium, a heavy isotope of hydrogen used to enhance the yield of nuclear weapons, but whose production stopped in 1988. The half-life decay of tritium is about 12 years, and the U.S. supply for helium-3 is fed by harvesting the gas from dismantled or refurbished nuclear weapons. However, production of helium-3 hasn’t kept pace with the exponential demand sparked by the Sept. 11 attacks. Projected demand for the nonradioactive gas in 2010 is said to be more than 76,000 liters per year, while U.S. production is a mere 8,000 liters annually, and U.S. total supply rests at less than 48,000 liters. This shortage wasn’t identified until a workshop put on by the Department of Energy’s Office of Nuclear Physics in August 2008. Between 2004 and 2008, about 25,000 liters of helium-3 annually was entering the U.S. from Russia, according to the testimony of Dr. William F. Brinkman, director of the Office of Science at DOE. Right around the time of the August workshop, Russia decided it was “reserving its supplies for domestic use.” Helium-3 neutron-detector systems were incorporated into many nuclear reactors designed and built General Electric, to measure power levels and initiate protective measures. Thomas R. Anderson, a representative from GE Energy, said his company has supplied more than 35,000 detectors around the world to monitor nuclear smuggling. The shortage is so severe, explained Dr. William K. Hagan, acting director of the Domestic Nuclear Detection Office at DHS, that even handheld and backpack detectors used by the U.S. Coast Guard, Customs and Border Protection, and Transportation Security Administration would be affected. According to the hearing’s charter, U.S. exports of the precious gas have ceased, and the International Atomic Energy Agency has been informed that it must diversify its helium-3 sources used for their nuclear-nonproliferation work. A lack of helium-3 will also adversely affect the oil and gas industry. These detectors are used to locate hydrocarbon reservoirs, and several measurement tools are designed around the use of helium-3, said GE Energy rep Anderson. Other affected industries include cryogenic research and magnetic resonance imaging. So far, the alternatives to helium-3 have been hard to come by. The Domestic Nuclear Detection Office of DHS is studying boron trifluoride as a cost-effective replacement for helium-3, but the gas is classified as a hazardous material. Other projects under consideration include lithium-loaded glass fibers and complex material like, cesium-lithium-yttrium-chloride, called “click.” However, none has been commercialized or rigorously tested. “Up to six different neutron-detection technologies may be required to replace helium-3 detectors,” for its four main uses, said Anderson. “[A] drop-in replacement technology for helium-3 does not exist today.”

Helium-3 Good: Exploration

He-3 mining initiative leads to colonizing Moon and Mars

Johnstone ‘11 (Bruce, leader post at the Canwest News Service, on an interview with Harrison Schmitt, former NASA astronaut, geologist, and Senator, 05/04/2011, Nexus, “Astronaut plans $15 Billion Lunar Mining Scheme”) DOA: 07/20/2011

The last man to set foot on the moon wants to go back, only this time to mine a rare element used in the production of fusion energy -a waste-free form of nuclear energy that could help power the planet in the 21st century. Harrison Schmitt, the first geologist and the last of 12 men who left their footprints on the moon, is promoting an ambitious $15-billion US project to obtain helium-3 (He-3) -an isotope of the inert element -that is rare on earth, but relatively abundant on the moon. What Schmitt helped discover during his 75-hour sojourn on Taurus-Littrow, a lunar valley deeper than the Grand Canyon bordered by mountains up to 7,000-feet (2,133metres) high, was the mixed layer of material called regolith contained small amounts of helium-3. "Helium-3 is a nearly ideal fuel for fusion nuclear power . It's ideal because it produces little or no radioactive waste, unlike almost all other nuclear systems.'' Containing 20 parts per billion of helium-3, about 100 kg of He-3 could provide sufficient fuel to allow a fusion reactor to generate 1,000 megawatts (MW) of power for a year, Schmitt said. "That 100 kg could be produced by mining the lunar regolith to a depth of three metres and an area of about two square kilometres,'' Schmitt said. The value of that energy is about $140 million (based the energy equivalent in coal at today's prices). Schmitt believes the commercial feasibility of He-3 as a fuel source for nuclear fusion could be proven with a $5-billion US demonstration plant. Another $5 billion US could "re-create" the Saturn V-class launch vehicle or rockets used to propel the Apollo astronauts into space. The lunar settlement required to mine the He-3 -"basically a company town on the moon" -would cost another $2.5 billion US. As an added bonus, the helium-3 initiative would also help the U.S. send human beings to Mars. "I believe the first human mission to Mars could be launched in 2025 because the development of the helium-3 initiative would also develop just about everything we would need to do in order to start that process of going to Mars -large rockets, the ability to work and live on another space body and the like.'' Following his speech, Schmitt said his $15-billion project, which he outlined in his 2006 book, Return to the Moon, could be implemented over 15 or 20 years. Far from being "out of this world,'' Schmitt believes this lunar mining venture could be financed primarily by the private sector. "If NASA or some other government space agency decides they're going to support technology development, then that will improve the financial position (of the helium-3 project). Unfortunately, when you start getting governments involved, it also prolongs the time and also raises the cost. So I'd rather see it entirely done by the private sector." Schmitt, who also served a sixyear stint as U.S. senator starting in 1977, said the He-3 project could also jump-start the U.S.-planned mission to Mars for 2030. "Having an upgraded heavy-lift launch vehicle, like the Saturn V, would be a major part of what you'd require for a Mars expedition. In addition, becoming really familiar with living and working in space on the moon . would certainly give you the experience base you need to do that on Mars." Not only that, but the helium-3 project could provide the fuel to get a manned mission to Mars. "(Helium-3) also is an ideal rocket fuel. Fusion rockets to allow you to accelerate and decelerate on the way to Mars would shorten the timeframe that human beings are exposed to radiation in space." In fact, if the He-3 project goes ahead, it would almost certainly expedite the manned mission to Mars. "If you got going aggressively and successively on a helium-3 initiative . then you would be putting yourself in a position that by 2025 you could have the first Mars mission going as well.''

REEs Good: Energy

Lunar Mining answer to declining REEs

The Greater World ’10 ( “With Rare Earth Materials Declining, Perhaps We Need Another Moon Mission” October 30, 2010, <http://www.lockergnome.com/greaterworld/2010/10/30/with-rare-earth-materials-declining-perhaps-we-need-another-moon-mission/>)

There have been more than a few stories about the fact tat the elements we call rare earths, elements in the Lanthanide and Actinide sections of the periodic table, are known to be mostly located in China these days, and China is limiting or stopping their export. This presents a huge problem for high technology, such as cell phones, hard drives, and many other things we now take for granted. There just is not enough for the continued production at current, or possibly, in some cases, accelerating levels, Because of this, there are massive campaigns to conserve what we have, and recycling is much more than a green thing these days, it becomes a point of purpose for many who wish to be able to continue on the path we are on With that in mind, it seems unusually fortuitous that news of the findings of the LCROSS mission of last year, the rocket that crashed into the moon to check for possible water, also found silver under the moon dust that was kicked up. Since the origins of the moon seem to vacillate in theories of the cosmos, it depends on where you come down as to whether you believe that it was captured as it came near the Earth, or was once a part of it, as to whether a mission to the moon may be helpful for the designs of retrieving these elements needed by the style of life to which we have become accustomed. Either way, it must be known that there are massive amounts of elements that are untapped, and since we might want to establish a base on the moon for other reasons, those elements could be sought while setting up the base to serve as a way station for other journeys to farther destinations. The title of the 1909 hit song By the Light of the Silvery Moon was not just poetic, it was also prophetic. A NASA spacecraft that crashed into the moon last year has found what appears to be silver, perhaps buried under a small layer of moon dust. Last October, NASA crash-landed a rocket near the lunar south pole, [lofting water in the resulting debris](http://www.newscientist.com/article/dn18155-impact-reveals-lunar-water-by-the-bucketful.html). Newly published studies of this mission, called LCROSS, reveal that about 5.6 per cent of the ejected material was water, and that similar concentrations of water may exist under the surface in a "permafrost" layer. Lead scientist [Anthony Colaprete](http://www.nasa.gov/centers/ames/research/2007/colaprete.html) at NASAs Ames Research Center in California estimates that there could be a billion gallons of water within 10 kilometres of the probes impact site. Other chemicals were also detected in the impact plume by a spacecraft flying behind the impactor. "Were seeing a kitchen sink of other stuff that may be useful for human exploration," says Michael Wargo, NASAs chief lunar scientist. Silver is very good, as it is the best conductor of electricity currently known. Also, where silver is found on Earth, other similar metals are usually found, such as gold (used in printed circuits among other things), platinum (used in many reactions as a catalyst), and [palladium](http://en.wikipedia.org/wiki/Palladium) (useful in many of the same things). If we found huge deposits of these materials, as well as water, it would make the journey to the moon, and subsequent journeys back from it to deliver minerals, pay for itself. One of the big surprises was two strong ultraviolet emission lines of silver. Because they appeared a few seconds after impact, Colaprete and his colleagues suspect that the silver might be in a layer of rock buried below the surface. Hopping around To create the observed spectral lines, the silver would have to be much more concentrated than the 100 parts per billion measured in rocks returned by the Apollo astronauts. On Earth, silver is concentrated by geologic processes such as flowing water, but such processes do not operate on the moon. So what might be concentrating the silver? One theory holds that volatile elements, such as mercury and magnesium, may hop along the moons surface one atom at a time until they hit a "cold trap" ? such as the permanently shadowed crater LCROSS smashed into “ and stick. Silver is not usually considered a volatile, but [Robert Wegeng](http://energyandefficiency.pnl.gov/staff/staff_info.asp?staff_num=1556) of the Pacific Northwest National Laboratory in Richland, Washington, who is not a member of the mission team, says it probably behaves like one in the vacuum and temperature conditions on the moon. Other useful metals, such as tellurium, indium, and selenium, may behave the same way, he says. All of these elements are put to good use in various modern circuitry; [selenium](http://en.wikipedia.org/wiki/Selenium) is very useful as a part of many electronic items. [Paul Spudis](http://www.spudislunarresources.com/) of the Lunar and Planetary Institute in Houston, Texas, cautions that the spectral lines are not definitive. "We really need a surface rover mission," he says. "We can argue about emission spectra from now until doomsday, but I want an on-the-spot measurement before Ill finally believe it." A surface rover mission would be a start, but a manned mission, equipped with the proper tools for extraction, and verification, is where the œrubber will meet the road. As we seem to be unable to control our populations here on Earth, and the raw materials for a modern life are either controlled strictly or are running out in raw form, it is important that we seek new supplies of them, so as to continue our lives in their current form.

REEs Good: Security

REE’s available on the Moon can be useful for U.S. national security

**David 10**, (Leonard Simon SPACE.com's Space Insider Columnist, 10/4/2010, <http://www.space.com/9250-mining-rare-minerals-moon-vital-national-security.html>, “Is Mining Rare Minerals on the Moon Vital to US Security”, space.com) Accessed 07/18/11

For instance, a recent report from the Congressional Research Service ? a study arm of the U.S. Congress ? reviewed the worldly use of rare earth elements for national defense.The report looked at the production of elements such as europium and tantalum, among others, outside the United States and flagged the important issue of supply vulnerability.The study pointed out that rare earth elements are used for new energy technologies and national security applications and asked: Is the United States vulnerable to supply disruptions of these elements? Are they essential to U.S. national security and economic well-being?Among the policy options flagged in the Congressional Research Service assessment is establishing a government-run economic stockpile and/or private-sector stockpiles. Doing so "may be a prudent investment," the study noted, and would contain supplies of specific rare earth elements broadly needed for "green initiatives" and defense applications.Given all the mineral mischief here on Earth, the moon could become a wellspring of essential resources ? but at what quality, quantity and outlay to extract? [10 Coolest New Moon Discoveries]Providing a lunar look-see is Carle Pieters, a leading planetary scientist in the Department of Geological Sciences at Brown University in Providence, R.I."Yes, we know there are local concentrations of REE on the moon," Pieters told SPACE.com, referring to rare earth elements by their acronym REE. "We also know from the returned samples that we have not sampled these REE concentrations directly, but can readily detect them along a mixing line with many of the samples we do have."Pieters is also principal investigator for NASA?s Moon Mineralogy Mapper, known as M3, which was carried on India?s Chandrayaan-1 lunar-orbiting spacecraft. That probe was lofted by the Indian Space Research Organization in October 2008 and operated around the moon until late August 2009.Among other findings, the M3 gear found a whole new range of processes for mineral concentrations on the moon unappreciated until now.For example, the M3 experiment detected a new lunar rock ? a unique mixture of plain-old plagioclase ? plentiful in the Earth?s crust and the moon?s highlands ? and pink spinel, an especially beautiful arrangement of magnesium, aluminum and oxygen that, in its purest forms, is prized as a gemstone here on Earth.What about the whereabouts of precious elements sitting there on our celestial neighbor in gravitational lock? Pieters said lunar scientists have a good idea how lunar rare earth elements became concentrated ? it occurred as part of the moon's magma ocean differentiation sequence. But it is now also recognized that "early events disrupted and substantially reorganized that process in ways we are still trying to decipher," she added.With the recent, but limited, new data for the moon from the international fleet of lunar orbiters with remote sensing instruments ?? from Europe, Japan, China, India and now the United States, "we are beginning to see direct evidence for the activity of geologic processes that separate and concentrate different minerals," Pieters said.On the moon, these areas and outcrops are local and small. Exposure is largely dependent on using impact craters as probes to the interior.Current data are only sufficient to indicate the presence of some concentrations of minerals, but are inadequate to survey and map their character and distribution, Pieters observed.

AT: Global warming isn’t real

Disregard their lies—warming is real and anthropogenic

Geological Society of America, nonprofit organization dedicated to the advancement of the geosciences, “Climate Change,” GSA Position Statement, revised April 2010, http://www.geosociety.org/positions/pos10\_climate.pdf

Scientific advances in the first decade of the 21st century have greatly reduced previous uncertainties about the amplitude and causes of recent global warming. Ground‐station measurements have shown a warming trend of ~0.7 °C since the mid‐ 1800s, a trend consistent with (1) retreat of northern hemisphere snow and Arctic sea ice in the last 40 years; (2) greater heat storage in the ocean over the last 50 years; (3) retreat of most mountain glaciers since 1850; (4) an ongoing rise of global sea level for more than a century; and (5) proxy reconstructions of temperature change over past centuries from ice cores, tree rings, lake sediments, boreholes, cave deposits and corals. Both instrumental records and proxy indices from geologic sources show that global mean surface temperature was higher during the last few decades of the 20th century than during any comparable period during the preceding four centuries (National Research Council, 2006). Measurements from satellites, which began in 1979, initially did not show a warming trend, but later studies (Mears and Wentz, 2005; Santer et al., 2008) found that the satellite data had not been fully adjusted for losses of satellite elevation through time, differences in time of arrival over a given location, and removal of higher‐elevation effects on the lower tropospheric signal. With these factors taken into account, the satellite data are now in basic agreement with groundstation data and confirm a warming trend since 1979. In a related study, Sherwood et al. (2005) found problems with corrections of tropical daytime radiosonde measurements and largely resolved a previous discrepancy with ground‐station trends. With instrumental discrepancies having been resolved, recent warming of Earth’s surface is now consistently supported by a wide range of measurements and proxies and is no longer open to serious challenge. The geologic record contains unequivocal evidence of former climate change, including periods of greater warmth with limited polar ice, and colder intervals with more widespread glaciation. These and other changes were accompanied by major shifts in species and ecosystems. Paleoclimatic research has demonstrated that these major changes in climate and biota are associated with significant changes in climate forcing such as continental positions and topography, patterns of ocean circulation, the greenhouse gas composition of the atmosphere, and the distribution and amount of solar energy at the top of the atmosphere caused by changes in Earth's orbit and the evolution of the sun as a main sequence star. Cyclic changes in ice volume during glacial periods over the last three million years have been correlated to orbital cycles and changes in greenhouse gas concentrations, but may also reflect internal responses generated by large ice sheets. This rich history of Earth's climate has been used as one of several key sources of information for assessing the predictive capabilities of modern climate models. The testing of increasingly sophisticated climate models by comparison to geologic proxies is continuing, leading to refinement of hypotheses and improved understanding of the drivers of past and current climate change. Given the knowledge gained from paleoclimatic studies, several long‐term causes of the current warming trend can be eliminated. Changes in Earth’s tectonism and its orbit are far too slow to have played a significant role in a rapidly changing 150‐year trend. At the other extreme, large volcanic eruptions have cooled global climate for a year or two, and El Niño episodes have warmed it for about a year, but neither factor dominates longer‐term trends. As a result, greenhouse gas concentrations, which can be influenced by human activities, and solar fluctuations are the principal remaining factors that could have changed rapidly enough and lasted long enough to explain the observed changes in global temperature. Although the 3rd IPCC report allowed that solar fluctuations might have contributed as much as 30% of the warming since 1850, subsequent observations of Sun‐like stars (Foukal et al., 2004) and new simulations of the evolution of solar sources of irradiance variations (Wang et al., 2005) have reduced these estimates. The 4th (2007) IPCC report concluded that changes in solar irradiance, continuously measured by satellites since 1979, account for less than 10% of the last 150 years of warming. Greenhouse gases remain as the major explanation. Climate model assessments of the natural and anthropogenic factors responsible for this warming conclude that rising anthropogenic emissions of greenhouse gases have been an increasingly important contributor since the mid‐1800s and the major factor since the mid‐1900s (Meehl et al., 2004). The CO2 concentration in the atmosphere is now ~30% higher than peak levels that have been measured in ice cores spanning 800,000 years of age, and the methane concentration is 2.5 times higher. About half of Earth’s warming has occurred through the basic heat‐trapping effect of the gases in the absence of any feedback processes. This “clear‐sky” response to climate is known with high certainty. The other half of the estimated warming results from the net effect of feedbacks in the climate system: a very large positive feedback from water vapor; a smaller positive feedback from snow and ice albedo; and sizeable, but still uncertain, negative feedbacks from clouds and aerosols. The vertical structure of observed changes in temperature and water vapor in the troposphere is consistent with the anthropogenic greenhouse‐gas “fingerprint” simulated by climate models (Santer et al., 2008). Considered in isolation, the greenhouse‐gas increases during the last 150 years would have caused a warming larger than that actually measured, but negative feedback from clouds and aerosols has offset part of the warming. In addition, because the oceans take decades to centuries to respond fully to climatic forcing, the climate system has yet to register the full effect of gas increases in recent decades.

Solvency: Exploration

Plan solves asteroid “get off the rock” impact, and energy.

Whitesides 08 (George T. Whitesides executive director national space society before the subcommittee on space, aeronautics, and related sciences, Senate Hearing on “Reauthorizing the Vision for Space Exploration” May 7, 2008 Chairman Nelson, Ranking Member Vitter, and members of the subcommittee. <http://www.spaceref.com/news/viewsr.html?pid=27921> )

There are vast numbers of asteroids in near-Earth orbits. Though it may seem unlikely, if we do nothing, sooner or later we will be hit by an asteroid large enough to threaten life on Earth. Given the nature of this threat, the space program is a logical place to start developing strategies for overcoming it. This is environmental protection of the highest order.

In October of 1990 a very small asteroid struck the Pacific Ocean with a blast about the size of the atomic bomb that leveled Hiroshima, killing roughly thousands of people in seconds. If this asteroid had arrived ten hours later, it would have struck in the middle of more than a million U.S. and Iraqi soldiers preparing for war. How would America have reacted to what looked like a nuclear attack?

In 1908 a small asteroid (perhaps 50 meters across) hit Tunguska, Siberia and flattened 60 million trees. That asteroid was so small it never even hit the ground, just exploded in mid-air. If it had arrived 4 hours and 52 minutes later, it could have hit St. Petersburg. At the time, St. Petersburg was the capital of Russia with a population of a few hundred thousand. The city would have ceased to exist. As it was, dust from the blast lit up the skies of Europe for days. Asteroid strikes this size probably happen about once every one hundred years. There was another Tunguska-class strike in the Brazilian rain forest on August 13, 1930. Sixty-five million years ago a huge asteroid several kilometers across slammed into the Yucatan Peninsula in Mexico. This is the event that is thought to have caused the extinction of the dinosaurs (and many other species). The explosion was the equivalent of about 200 million megatons of dynamite. The blast turned the air around it into plasma — a material so hot that electrons are ripped from the atomic nucleus and molecules cannot exist. This scenario has been repeated perhaps once every 100 million years or so. As many as two-thirds of all species that ever existed may have been terminated by asteroids hitting the Earth.

We know about the asteroid that killed the dinosaurs because we found the crater. But when an asteroid hits the ocean, there may not be a crater. If a 400-meter (four football fields) diameter asteroid were to fall into the Atlantic Ocean, it would cause a tsunami 60 meters high.

The only way to eliminate the threat of asteroids is to detect and divert them. A vigorous space-based civilization capable of reaching, exploring, and diverting asteroids into useful, safe orbits would have enormous economic incentives to find and use every asteroid passing near Earth. The asteroids could be found, diverted, and mined for their materials, including platinum-group metals, water ice, and iron, which could be used to make steel. This would defuse the threat, make a lot of people extremely rich, and keep an entire world safe.

Solvency: Exploration

The moon is a prereq to deep space exploration

Hatch 10 (Hatch, Benjamin D. Executive Notes and Comments Editor, Emory International Law Review. “DIVIDING THE PIE IN THE SKY: THE NEED FOR A NEW LUNAR RESOURCES REGIME.” Vol. 24 Rev. 229. 2010. <http://www.gpo.gov/fdsys/pkg/CHRG-108hhrg92757/pdf/CHRG-108hhrg92757.pdf>.

Regardless of whether the Moon is able to aid humanity in solving the impending energy crisis, the satellite will have further importance as states begin evaluating the feasibility of space colonization. While space colonization may seem like the stuff of pulp science fiction, states are actually considering attempting to build Moon bases and, in turn, populating Mars.59 The International Space Station is a preliminary venture to determine the long-term effects of living outside the confines of the Earth.60 Additionally, the Moon may be able to furnish valuable mineral ores not commonly found on the Earth.61 As a result, a number of states are in the initial stages of planning on visiting the Moon to reap its potential benefits.62 For these reasons, a new space race is about to commence, which will lead not only to competition on the Earth but to a jockeying for power in space and on the Moon itself. As a result, the law of outer space, and particularly of the now than at any time since the end of the Cold War.

Solvency: Exploration

**Moon base key to human survival**

Scott Simmie 06 (The Toronto Star, Lexis)

It sounds more than a little like a science fiction flick.

Human beings, colonizing a distant planet, in order to escape a potentially doomed Earth.

Last week, one of the world's most renowned astrophysicists outlined precisely that scenario. Speaking in Hong Kong, Stephen Hawking said, "It is important for the human race to spread out into space for the survival of the species."

Within 24 hours, his comments had prompted more than 2,000 responses on [www.thestar.com](http://www.thestar.com) - with people split fairly evenly on whether this was a good or bad idea. Some were skeptical.

While there are no immediate plans (nor is there the technology) to "colonize" some distant planet in the way Hawking described, some of the stepping stones for a long-term presence on the surface of the moon and beyond are the subject of serious scientific efforts.

Just last fall, NASA released a major report outlining the architecture required for its goal of establishing "a continuous human presence on the lunar surface to accomplish exploration and science goals ...

"The primary purpose of the mission is to transfer up to four crew members and supplies in a single mission to the outpost site for expeditions lasting up to six months. Every six months, a new crew will arrive at the outpost, and the crew already stationed there will return to Earth."

The space agency hopes to be able to accomplish this shortly after 2020 - when the first manned expedition is set to return to the moon.

Before this can happen, however, there are massive technological hurdles to overcome. It's not so much about getting there - we were able to do that in 1969. It's about staying there.

"To put a human colony of four or five scientists on the moon for any extended period of time, it's necessary to figure out how to produce the oxygen and water and propellant that might be required for simple life support, largely because it's too darned expensive to get it all the way from Earth and stockpile it there," says Dale Boucher, director of research and development at the Sudbury-based Northern Centre for Advanced Technology.

"So we have to figure out a way to do that. And right now, the only way to do that is to mine it out of the ground - out of the sub-surface sections of the moon."

It's known as In Situ Resource Utilization. Without it, a long-term human presence on another planet is considered unlikely, if not impossible.

To that end, the technology centre has been instrumental in linking some of the key players in Canada's mining industry with some of the top minds on space. Earlier this month, its annual Planetary and Terrestrial Mining Sciences Symposium attracted some 100 delegates to Sudbury, including experts from the Canadian Space Agency, NASA and the European Space Agency. Main sponsors of the event included giants INCO and Falconbridge.

"There's not a direct connect between space exploration and mining, until it's explained that mining is a requirement for any kind of human colony," says Boucher.

The technology centre has been working with NASA on a technique to extract water and hydrogen (needed as propellant) from simulated lunar "regolith," or fake moon dirt. NASA is also offering a $250,000 (U.S.) prize for anyone who can squeeze 2.5 kilograms of oxygen out of 100 kilograms of the same stuff.

But where do you find that fake dirt?

Melissa Battler, doing a masters in planetary geology at the University of New Brunswick's Planetary and Space Science Centre, has been working more than two years with the technology centre and others to produce a terrestrial version of dirt nearly identical to what's found on the moon's highlands.

"There are lots of people studying this, and lots of progress being made," she says.

Okay. Water you can drink. Hydrogen you can use as fuel. But you can't eat moon rocks.

"Food drives the equation for how long and how far away you can go from Earth," says Mike Dixon, professor and chair of the biology department at the University of Guelph.

"Mars is six months away, so you've got to take enough groceries for two or three years." And that, he says, is impossible.

Yet here, too, work is being conducted that may enable long-term human habitation. Dixon is also director of the Controlled Environment Systems Research Facility at Guelph, where plants are grown in hypobaric chambers that can simulate the lower (or non-existent) atmospheric pressures found outside of Earth's cocoon.

"The main question we're asking is: 'How can you grow food crops in the strange environments that we will encounter when we go to the moon and Mars?'" he says.

Dixon has already found that plants can be grown down to 10 per cent of Earth's atmospheric pressure.

Melissa Battler believes there's another reason for colonizing space that transcends Hawking's rationale.

"My biggest personal reason is because - and this sounds cheesy - it's almost our destiny to do so," she says. "We're humans. We're explorers. This is what we do."

Solvency: Exploration (1/2)

**Colonizing the moon would bring with it countless benefits and ultimately save humanity.**

**Lowman, 2008** (Paul D., Jr. Geophysicist and contributor to NASA. “Why Go Back to the Moon?” 07/20/11 <http://www.nasa.gov/centers/goddard/news/series/moon/lowman_intro.html>

"All civilizations become either spacefaring or extinct." -- Carl Sagan. President Bush’s 2004 proposal to return to the Moon, this time "to stay" with a lunar outpost, has stimulated vigorous debate. A Los Angeles Times editorial (Dec.10, 2006), for example, argued forcefully that robots can do anything necessary on the Moon, and that human participation is not really needed. Given the stunning performance of American robots on Mars, this point of view is worth serious discussion. Why should we send humans back to the Moon? After all, we’ve already done it, six times, in the 20th century. Taking the Los Angeles Times title, "Don’t colonize the Moon," at face value, I will first point out that the Vision for Space Exploration proposes an "outpost" on the Moon. This is hardly colonization in the sense that Europeans colonized North America. Current NASA plans are in a preliminary stage, but envisage something comparable to Little America, or the Amundsen-Scott South Pole base. These terrestrial examples – operated by humans, incidentally – have proven their scientific value over and over, helping to produce valuable evidence about the ozone hole and global warming. The Times editorial echoes identical arguments advanced in the early 1960s, that robotic missions could produce as much as manned ones. The US did in fact have a large robotic lunar program, including 3 Rangers, 5 Surveyors, 5 Lunar Orbiters, and 2 Radio Astronomy Explorers, not counting the few unsuccessful missions. So NASA did use robots in our first lunar program. But as argued at the time, human abilities on the surface later proved far superior to robotic ones. Neil Armstrong and his colleagues demonstrated that humans on the spot provide instant interpretation of their environment, guided by color, 3D, high resolution human vision that is only now being approached by robotic systems. Even encumbered by space suits, they could instantly recognize and collect invaluable samples such as the "Genesis Rock" of Apollo 15, an anorthosite that has proven essential to understanding the geologic history of the Moon. When the Apollo 17 rover lost a fender – which might have terminated a robotic rover’s mission – astronauts Cernan and Schmitt managed a field repair and kept driving. All the Apollo astronauts emplaced complex geophysical instrument stations, most operating for years until budget cuts forced them to be turned off. The Soviet Union carried out several brilliant robotic surface missions, starting with the very first soft landing, Luna 9. The USSR operated two robotic rovers on the Moon for months, and carried out three robotic sample return missions, both accomplishments never matched by the US or any other country. Yet no one would seriously argue that these missions produced anything close to the results of, for example, the Apollo 15 mission. The Apollo 15 astronauts Scott and Irwin returned tens of pounds of rock and soil (including the "Genesis Rock"), drove their rover miles along the front of the lunar Apennines, drilled holes for and emplaced probes for heat flow measurements, and took hundreds of high-resolution photos of their surroundings. Returning to the 21st century: Given these splendid accomplishments by astronauts on the Moon, why bother to go back? Should we not "declare victory" and stay on (or near) Earth? Here are some reasons go back, although not necessarily to "colonize" the Moon. First, and most fundamental: the last few decades of space exploration and astronomy have shown that the universe is violent and dangerous, at least with respect to human life. To give a pertinent example: in 1908 an object of unknown nature – probably a comet – hit Siberia with a force equivalent to a hydrogen bomb. Had this impact happened a few hours later, allowing for the Earth’s rotation, this object would have destroyed St. Petersburg and probably much else. Going back some 65 million years, it is now essentially proven that an even greater impact wiped out not only the dinosaurs but most species living on Earth at the time. The importance of catastrophic impacts has only been demonstrated in recent decades, and space exploration has played a key role. The bleak conclusion to which these facts point is that humanity is vulnerable as long as we are confined to one planet. Obviously, we must increase our efforts to preserve this planet and its biosphere, an effort in which NASA satellites have played a vital role for many years. But uncontrollable external events may destroy our civilization, perhaps our species. We can increase our chances of long-term survival by dispersal to other sites in the solar system. Where can we go? At the moment, human life exists only on the Earth. But with modern technology, there are several other possibilities, starting with the Moon itself. Men have lived on the Moon for as long as three days, admittedly in cramped quarters, but they found the lunar surface easy to deal with and the Moon’s gravity comfortable and helpful. (Dropped tools, for example, didn’t float away into space as they do occasionally in Earth orbit.) To be sure, it would be an enormous and probably impossible task to transform the Moon into another Earth. However, it is clear that a lunar outpost comparable to, for example, the Little America of the 1930s, is quite feasible. But what could such an outpost accomplish? First, it could continue the exploration of the Moon, whose surface area is roughly that of North and South America combined. Six "landings" in North America would have given us only a superficial knowledge of this continent, and essentially none about its natural resources such as minerals, oil, water power, and soil. The Moon is a whole planet, so to speak, whose value is only beginning to be appreciated. The Moon is not only an interesting object of study, but a valuable base for study of the entire Universe, by providing a site for astronomy at all wavelengths from gamma rays to extremely long radio waves. This statement would have been unquestioned 30 years ago. But the succeeding decades of spectacular discoveries by space-based instruments, such as the Hubble Space Telescope, have led many astronomers such as Nobel Laureate John Mather to argue that the Moon can be by-passed, and that instruments in deep space at relatively stable places called Lagrangian points are more effective. A meeting was held at the Space Telescope Science Institute in Baltimore, in November 2006, on "Astrophysics Enabled by the Return to the Moon." This institute runs the Hubble Space Telescope program. However, the consensus emerging from the Baltimore meeting was that there are still valuable astronomical uses for instruments on the lunar surface. For example, low-frequency radio astronomy can only be effective from the far side of the Moon, where static from the Earth’s aurora is shielded. Another example of Moon-based astronomy can be the search for extraterrestrial intelligence (SETI), by radio telescopes that on the far side would be shielded from terrestrial interference. Small telescopes on the Moon’s solid surface could be linked to form interferometer arrays with enormous resolving power. Astronomy in a limited sense has already been done from the Moon, namely the Apollo 16 Ultraviolet telescope emplaced by Apollo astronauts and before that, the simple TV observations of Earth-based lasers by the Surveyor spacecraft. The much-feared lunar dust had no effect on these pioneering instruments. The Moon may offer mineral resources, so to speak, of great value on Earth. Apollo 17 astronaut Harrison Schmitt, working with the Fusion Technology Institute of the University of Wisconsin, has shown that helium 3, an isotope extremely rare on Earth, exists in quantity in the lunar soil, implanted by the solar wind. If – a very big if – thermonuclear fusion for energy is produced on Earth, helium 3 would be extremely valuable for fusion reactors because it does not make the reactor radioactive. A more practicable use of helium 3, being tested at the University of Wisconsin, is the production of short-lived medical isotopes. Such isotopes must now be manufactured in cyclotrons and quickly delivered before they decay. But Dr. Schmitt suggests that small helium 3 reactors could produce such isotopes at the hospital. In any event, research on the use of helium 3 would clearly benefit if large quantities could be exported to the Earth. Returning to the most important reason for a new lunar program, dispersal of the human species, the most promising site for such dispersal is obviously Mars, now known to have an atmosphere and water. Mars itself is obviously a fascinating object for exploration. But it may even now be marginally habitable for astronaut visits, and in the very long view, might be "terraformed," or engineered to have a more Earth-like atmosphere and climate. This was described in Kim Stanley Robinson’s trilogy, Red Mars and its successors Green and Blue Mars.

<card continues>

Solvency: Exploration (2/2)

<card continued>

A second Earth, so to speak, would greatly improve our chances of surviving cosmic catastrophes. Where does the Moon fit into this possibility? First, it would continue to give us experience with short interplanetary trips, which is what the Apollo missions were. These would demonstrably be relatively short and safe compared to Mars voyages, but would provide invaluable test flights, so to speak. More important, shelters, vehicles, and other equipment built for the Moon could be over-designed, and with modification could be used on Mars after being demonstrated at a lunar outpost. Where could humanity expand to beyond Mars and the Moon? At this point, still early in the history of space exploration, it is impossible to say. The Galilean satellites of Jupiter, in particular Ganymede, might be habitable, but we venture here far into the field of science fiction. However, an outpost on the Moon is clearly possible, and would provide an invaluable stepping-stone to Mars. A species living on three planets would be far more likely to have a long history than one living only on the Earth. To put the arguments for a return to the Moon, and a lunar outpost, in the most general terms: the Moon is essentially a whole planet, one that has so far been barely touched. But this new planet is only a few days travel away and we have already camped on it. To turn our backs on the Moon would be equivalent to European exploration stopping after Columbus’s few landings, or China’s destruction of its giant ships to concentrate on domestic problems in the 15th century.

Solvency: Helium-3

HELIUM 3 VALUABLE AND READY TO BE MINED, EITHER BY NASA OR PRIVATE INDUSTRY

Schmitt 05 (PhD Harvard University, Writer Popular Mechanics, US Senator from New Mexico. 1Search and Discovery Article #70012 (2005)Posted January 14, 2005 <http://popularmechanics.com/science/space/2004/10/mining_moon/>)

A sample of soil from the rim of Camelot crater slid from my scoop into a Teflon bag to begin its trip to Earth with the crew of Apollo 17. Little did I know at the time, on December 13, 1972, that sample 75501, along with samples from Apollo 11 and other missions, would provide the best reason to return to the moon in the 21st century (Figure 1). That realization would come 13 years later. In 1985, young engineers at the University of Wisconsin discovered that lunar soil contained significant quantities of a remarkable form of helium (Figure 2). Known as helium-3, it is a lightweight isotope of the familiar gas that fills birthday balloons. Small quantities of helium-3 previously discovered on Earth intrigued the scientific community. The unique atomic structure of helium-3 promised to make it possible to use it as fuel for nuclear fusion, the process that powers the sun, to generate vast amounts of electrical power without creating the troublesome radioactive byproducts produced in conventional nuclear reactors. Extracting helium-3 from the moon and returning it to Earth would, of course, be difficult, but the potential rewards would be staggering for those who embarked upon this venture. Helium-3 could help free the United States—and the world—from dependence on fossil fuels. That vision seemed impossibly distant during the decades in which manned space exploration languished. Yes, Americans and others made repeated trips into Earth orbit, but humanity seemed content to send only robots into the vastness beyond. That changed on January 14, 2004, when President George W. Bush challenged NASA to “explore space and extend a human presence across our solar system.” It was an electrifying call to action for those of us who share the vision of Americans leading humankind into deep space, continuing the ultimate migration that began 42 years ago when President John F. Kennedy first challenged NASA to land on the moon. We can do so again. If Bush’s initiative is sustained by Congress and future presidents, American leadership can take us back to the moon, then to Mars and, ultimately, beyond. Although the president’s announcement did not mention it explicitly, his message implied an important role for the private sector in leading human expansion into deep space. In the past, this type of public-private cooperation produced enormous dividends. Recognizing the distinctly American entrepreneurial spirit that drives pioneers, the President’s Commission on Implementation of U.S . Space Exploration policy subsequently recommended that NASA encourage private space-related initiatives. I believe in going a step further. I believe that if government efforts lag, private enterprise should take the lead in settling space. We need look only to our past to see how well this could work. In 1862, the federal government supported the building of the transcontinental railroad with land grants. By the end of the 19th century, the private sector came to dominate the infrastructure, introducing improvements in rail transport that laid the foundation for industrial development in the 20th century. In a similar fashion, a cooperative effort in learning how to mine the moon for helium-3 will create the technological infrastructure for our inevitable journeys to Mars and beyond. A Reason to Return Throughout history, the search for precious resources—from food to minerals to energy—inspired humanity to explore and settle ever-more-remote regions of our planet. I believe that helium-3 could be the resource that makes the settlement of our moon both feasible and desirable (Figure 1). Although quantities sufficient for research exist, no commercial supplies of helium-3 are present on Earth. If they were, we probably would be using them to produce electricity today. The more we learn about building fusion reactors, the more desirable a helium- 3-fueled reactor becomes. Researchers have tried several approaches to harnessing the awesome power of hydrogen fusion to generate electricity. The stumbling block is finding a way to achieve the temperatures required to maintain a fusion reaction. All material known to exist melt at these surface-of-the-sun temperatures. For this reason, the reaction can take place only within a magnetic containment field, a sort of electromagnetic Thermos bottle. Initially, scientists believed they could achieve fusion using deuterium, an isotope of hydrogen found in seawater. They soon discovered that sustaining the temperatures and pressures needed to maintain the so-called deuterium-deuterium fusion reaction for days on end exceeded the limits of the magnetic containment technology. Substituting helium-3 for tritium allows the use of electrostatic confinement, rather than needing magnets, and greatly reduces the complexity of fusion reactors as well as eliminates the production of high-level radioactive waste (Figure 3). These differences will make fusion a practical energy option for the first time. It is not a lack of engineering skill that prevents us from using helium-3 to meet our energy needs, but a lack of the isotope itself. Vast quantities of helium originate in the sun, a small part of which is helium-3, rather than the more common helium-4 (Figure 4). Both types of helium are transformed as they travel toward Earth as part of the solar wind. The precious isotope never arrives because Earth’s magnetic field pushes it away. Fortunately, the conditions that make helium-3 rare on Earth are absent on the moon, where it has accumulated on the surface and been mixed with the debris layer of dust and rock, or regolith, by constant meteor strikes (Figure 5). And there it waits for the taking. An aggressive program to mine helium-3 from the surface of the moon would not only represent an economically practical justification for permanent human settlements; it could yield enormous benefits back on Earth. Lunar Mining Samples collected in 1969 by Neil Armstrong during the first lunar landing showed that helium-3 concentrations in lunar soil are at least 13 parts per billion (ppb) by weight. Levels may range from 20 to 30 ppb in undisturbed soils. Quantities as small as 20 ppb may seem too trivial to consider. But at a projected value of $40,000 per ounce, 220 pounds of helium-3 would be worth about $141 million. Because the concentration of helium- 3 is extremely low, it would be necessary to process large amounts of rock and soil to isolate the material. Digging a patch of lunar surface roughly three-quarters of a square mile to a depth of about 9 ft. should yield about 220 pounds of helium-3— enough to power a city the size of Dallas or Detroit for a year. Although considerable lunar soil would have to be processed, the mining costs would not be high by terrestrial standards. Automated machines, perhaps like those shown in Figure 1, might perform the work. Extracting the isotope would not be particularly difficult. Heating and agitation release gases trapped in the soil. As the vapors are cooled to absolute zero, the various gases present sequentially separate out of the mix. In the final step, special membranes would separate helium-3 from ordinary helium. The total estimated cost for fusion development, rocket development, and starting lunar operations would be about $15 billion. The International Thermonuclear Reactor Project, with a current estimated cost of $10 billion for a proof-of-concept reactor, is just a small part of the necessary development of tritium-based fusion and does not include the problems of commercialization and waste disposal. The second-generation approach to controlled fusion power involves combining deuterium and helium-3. This reaction produces a high-energy proton (positively charged hydrogen ion) and a helium-4 ion (alpha particle). The most important potential advantage of this fusion reaction for power production as well as other applications lies in its compatibility with the use of electrostatic fields to control fuel ions and the fusion protons. Protons, as positively charged particles, can be converted directly into electricity, through use of solid-state conversion materials as well as other techniques. Potential conversion efficiencies of 70 percent may be possible, as there is no need to convert proton energy to heat in order to drive turbine-powered generators. Fusion power plants operating on deuterium and helium-3 would offer lower capital and operating costs than their competitors due to less technical complexity, higher conversion efficiency, smaller size, the absence of radioactive fuel, no air or water pollution, and only low-level radioactive waste disposal requirements. Recent estimates suggest that about $6 billion in investment capital will be required to develop and construct the first helium-3 fusion power plant. Financial breakeven at today’s wholesale electricity prices (5 cents per kilowatt-hour) would occur after five 1000-megawatt plants were on line, replacing old conventional plants or meeting new demand. New Spacecraft Perhaps the most daunting challenge to mining the moon is designing the spacecraft to carry the hardware and crew to the lunar surface. The Apollo Saturn V spacecraft remains the benchmark for a reliable, heavy-lift moon rocket. Capable of lifting 50 tons to the moon, Saturn V’s remain the largest spacecraft ever used. In the 40 years since the spacecraft’s development, vast improvements in spacecraft technology have occurred. For an investment of about $5 billion it should be possible to develop a modernized Saturn capable of delivering 100-ton payloads to the lunar surface for less than $1500 per pound. Returning to the moon would be a worthwhile pursuit even if obtaining helium-3 were the only goal. But over time the pioneering venture would pay more valuable dividends. Settlements established for helium-3 mining would branch out into other activities that support space exploration. Even with the next generation of Saturns, it will not be economical to lift the massive quantities of oxygen, water and structural materials needed to create permanent human settlements in space. We must acquire the technical skills to extract these vital materials from locally available resources. Mining the moon for helium-3 would offer a unique opportunity to acquire those resources as byproducts. Other opportunities might be possible through the sale of low-cost access to space. These additional, launch-related businesses will include providing services for government-funded lunar and planetary exploration, astronomical observatories, national defense, and long-term, on-call protection from the impacts of asteroids and comets. Space and lunar tourism also will be enabled by the existence of low-cost, highly reliable rockets. With such tremendous business potential, the entrepreneurial private sector should support a return to the moon, this time to stay. For an investment of less than $15 billion—about the same as was required for the 1970s Trans Alaska Pipeline—private enterprise could make permanent habitation on the moon the next chapter in human history. A Geologist Goes to the Moon BUDGET cuts, a public bored with space and fear of losing a crew—Apollo 13 was still a vivid memory—turned Apollo 17 into the last moon mission of the 20th century. NASA decided to get the most scientific data possible from its last lunar excursion and made a crew change: Harrison H. Schmitt became the first and only fully trained geologist to explore the moon (Figure 6). Schmitt was a natural choice. With a doctorate from Harvard University, he was already on the staff of the U.S. Geological Survey’s astrogeology branch in Flagstaff , Arizona. His job included training astronauts during simulated lunar field trips. There was only one hole in his résumé. Schmitt had never learned to fly. In 18 months he earned his wings, and became a jet plane and lunar landing module pilot. On Dec. 11, 1972, he and Eugene Cernan landed in the moon’s Taurus-Littrow Valley. On the first of three moonwalks, Schmitt’s scientifi c knowledge became evident. So did his enthusiasm. His periodic falls stopped hearts at Mission Control, which feared he would rip his spacesuit and die instantly. Four years after returning with 244 pounds of moon rocks, Schmitt was elected U.S. senator. from New Mexico. Now chairman of Albuquerque-based Interlune-Intermars Initiative, he is a leading advocate for commercializing the moon. –Stefano Coledan. Moon The discovery of a helium isotope, helium-3, on the moon (Figure 7) has given scientists ideas on how to produce electricity far more efficiently than with hydrocarbons or curent nuclear plants. The large amounts of energy would come without danger of releasing radioactive substances into the atmosphere. Mining the lunar surface would not be cheap; the investment would be comparable to building a major transcontinental pipeline. Mars Studies conducted by NASA and others have determined that water, rocket propellant, and chemicals needed to sustain a human outpost could be manufactured from martian soil and ice caps (Figure 7). Future astronauts might set up production plants that expand as others arrive. Eventually, the Mars base could become a resupply base. Asteroids Scientists believe these leftovers of the solar system’s formation (Figure 7), floating between the orbits of Jupiter and Mars, may contain rare elements and water. Mining these rocks, some as big as mountains, will be neither easy nor cheap. Using technologies previously developed to extract precious materials from the moon or Mars could make asteroids an attractive target, especially for a permanent human colony on the red planet. Astronauts would first practice rendezvous with asteroids. Then, after studying them, crews would return with mining equipment. Excavated ore could be trucked to a martian outpost.Titan As early as next year (2005), we may learn whether Saturn’s largest moon, Titan (Figure 7), preserves organic molecules similar to those believed to exist on primeval Earth. The Cassini-Huygens spacecraft is designed to determine whether the atmosphere of Titan indeed contains ammonia and hydrocarbons such as ethane and methane. All these chemicals contain a common element: hydrogen. Extracting this gas in a minus 400oF environment could be easier than on Earth since it would be already liquefied and ready to be used as the most powerful chemical rocket fuel. With organic chemicals as ingredients, a limitless array of synthetic materials could be manufactured. Space Sails Earthlings first learned about the existence of the solar wind 35 years ago when Apollo 11 astronauts Neil Armstrong and Buzz Aldrin deployed a silver-colored sheet on the moon. Scientists wanted to intercept particles coming from the sun. Taking advantage of this natural source of energy made perfect sense to some within the space community. A lightweight sail (Figure 7) could be folded and launched into space. Once in the vacuum of space, the frame attached to a spacecraft would deploy and the square-mile sail could push a spacecraft through interplanetary space faster than conventional propulsion systems, and reach the outer planets in one-fourth the time spacecraft currently take.

AT: Mining Impossible

Technology exists to harvest the energy rich helium-3 deposits on the moon

Lee ’10 THE EXPRESS (ADRIAN, FORMER NATIONAL NEWSPAPER JOURNALIST, FOUR YEARS ON STAFF OF TIMES AND DAILY EXPRESS, 3/24/2010, “TRUTH BEHIND THE NEW SPACE RACE; INDIA, CHINA, BRAZIL AND NOW EVEN BRITAIN HAVE ANNOUNCED MASSIVE NEW SPACE PROJECTS-ALL COMPETING WITH NASA TO HARVEST THE MOON’S PRICELESS COMPOUND THAT COULD POWER THE PLANET” LEXISNEXIS.COM. ACCESSED 7/18/11, LG)

The Moon, so neglected since the last landing in 1972, remains a huge source of untapped riches. Not far from its surface lies a source of power which, if successfully mined, could solve many of the world's energy needs for thousands of years to come. With its very different atmosphere to Earth the Moon has acted like a sponge and soaked up Helium-3, emitted from the Sun in the form of solar winds. According to space scientist and author Dr David Whitehouse just two payloads of Helium-3 in a Space Shuttle vessel could provide sufficient power for the US for a year, created using nuclear fusion. It's estimated that more than one million tonnes of this fuel lie buried on the Moon. One project proposed by the American space agency Nasa included founding a mine at one of the Moon's poles. The presence of Helium-3 was found in every sample collected during the first Moon landing. "Winning the space race gave the US a huge boost, " says Dr Whitehouse. "It is the single biggest event that the 20th century is remembered for. A space programme is an expression of a nation's confidence." At the height of the Cold War the landing was one of the defining moments of the 20th century and a crushing victory for the US against its Russian foe. If ways of getting heavy equipment to the Moon can be found, the technology exists to extract Helium-3, says Dr Whitehouse, who adds: "There are many other reasons to go back to the Moon because it is a unique place and has qualities such as a sterile environment and low gravity." Only a handful of other nations, currently led by China, are anywhere near ready to put a man on the Moon. Russia - which has already stated its intention to mine Helium-3 - Japan and India are the others. A European alliance has the technology to land there and we even have our own astronaut, Major Tim Peake, working for the European Space Agency. "China sees the benefits of Helium-3 and psychologically it would also affect America, " adds Dr Whitehouse. "India is also training astronauts, although it's a bit of a puzzle because they don't have rockets powerful enough to put people into space. For America, however, if the momentum it has gained over the past 50 years is lost it will be difficult to regain." Under the axed proposals, the US intended to reclaim the Moon in 2020. "That's still possible, " says Dr Whitehouse, who believes the US may yet have a rethink. "Now, though, I think it is 50-50 whether China will get there first." For Britain, the last developed nation to have its own space agency, it's a case of too little, too late. "Sadly, it's hard to see Britain ever getting independently involved in manned space flights. The Government only seems interested in sending satellites into space. Our space programme has just ambled along for years. We should be spending more money." It's claimed the current space budget is barely enough to buy a nose cone for a Space Shuttle, although the Government insists that the space industry is worth GBP 6.5billion a year to the UK economy. SOME experts insist there's little to be gained from going back to the Moon after such a long break but Dr Whitehouse believes the next country to conquer our near neighbour, 240,000 miles distant, will gain a major advantage. "This time it will not be grainy black-and-white pictures but in highdefinition colour and it will carry whole new meaning for whoever gets to the Moon next, " he says. "I remember when I was nine years old begging my father to be allowed to stay up to watch the Moon landing."If we are to get to Mars we will need to go to the Moon first. In my opinion, abandoning the Moon is a big mistake." The discovery last year of a significant amount of water under the lunar south pole brings the reality of establishing a permanent base on the Moon a step closer. The surface of the Moon is drier than any desert on our planet but scientists have long speculated that some permanently shadowed places might harbour huge stores of water, perhaps delivered by impacting comets billions of years ago. This water could sustain astronauts based at the lunar poles.

AT: Colonization Impossible

Lunar Colonization is possible and effective

Pelton, ‘11 (Joseph, “Finding Eden on the MOON,” The Futurist, May/June 2011, <http://findarticles.com/p/articles/mi_go2133/is_201105/ai_n57625395/>)

Viable, cost-effective and radiation- hardened habitat. The discovery of billions of gallons of water and other resources on the Moon suggests that such a habitat could be created largely from resources available on the lunar surface, and that a permanent colony could be established on the Moon at much lower cost than required to create another off-Earth habitat. The Moon may have as much as 80% of the materials needed to create the colony, and digging down to build the colony would provide significant radiation protection. Creating a space colony at a Lagrange point (one of five gravitationally stable positions in an orbital configuration with Earth) would re- quire lifting hundreds of tons of materials to this location at huge cost. Our proposed Eden 1 colony, in contrast, could include a material processing area from which communications, solarpower, and remote-sensing satellites could be fabricated and lowered to desired Earth orbits with substantial launch cost savings. Lunar manufacturing sites could also produce components for use on space stations, or even for buildings and homes back on Earth. With the Moon's material capacity, human centers there could make any number of things more affordable: Lowering material from space to Earth is much less costly than is building them on Earth and rocketing them up into space.  It could turn a profit relatively soon. A colony such as Eden 1 is the only human off-world activity that might reasonably be expected to realize an economic return within 20 to 30 years and could offer huge long-term economic returns. For example, the Moon could be the site for manufacturing satellites used in remote sensing, climate monitoring, and telecommunications. Compared with building satellites on Earth and launching them into space, the cost and power savings would be substantial. In time, such a station could provide substantial returns, based on a 20- to 30-year business plan that included consideration of reduced launch costs, power cost savings, and other such factors.

AT: Colonization Impossible—Farming

New experiments with liquid soil make it possible to farm on the moon

Mari, 2010 (A. Di finalist in MOON CAPITAL Competition, an international design challenge, “Shift Boston” <http://www.shiftboston.org/competitions/2010moon_finalists.php>)

A lunar intervention – an inflatable structure within a rigid membrane which converts existing lunar resources to sustain agriculture above the surface of the moon. A planting and mining strategy which utilizes lunar resources such as titanium and helium 3. The core idea of functionally combining agriculture with mining is interesting. The visual is superb.

Space farming is the most cost-efficient option for long-term colonization.

Tutton 2010 (CNN Contributor, “To Boldly Grow Where No One Has Grown Before,” 7/19/11, <http://articles.cnn.com/2008-05-20/tech/ceac.wheeler_1_international-space-station-russian-space-agencies-growth-chamber?_s=PM:TECH>

Raymond Wheeler, a plant physiologist at Kennedy Space Center, explained to CNN, "In the near term it's not needed, for example on the space station and initial short sorties to the moon, but as you go further and stay longer, regenerative systems become much more cost effective." Wheeler sees this development of space farming as a gradual process in which space outposts become increasingly self-sufficient. "It would probably be evolutionary," he said. "The first human missions to Mars might set out with everything stowed, but they might set up the beginnings of an in-situ production system -- maybe a plant chamber -- that you could use to grow perishable foods. You wouldn't be providing everything, but in subsequent missions if you returned there you could expand the infrastructure."

AT: Colonization Impossible—Farming

**A Lunar greenhouse makes it possible to grow plants on the moon**

**Stiles, 2010** (Ed, Professor at College of Engineering, University of Arizona, States News Service, “UA ENGINEERS BUILD LUNAR VEGETABLE GARDEN” 8/10/10, Lexis)

The first extraterrestrials to inhabit the moon probably won't be little green men, but they could be little green plants. Researchers at the University of Arizona Controlled Environment Agriculture Center, known as CEAC, are demonstrating that plants from Earth could be grown hydroponically (without soil) on the moon or Mars, setting the table for astronauts who would find potatoes, peanuts, tomatoes, peppers and other vegetables awaiting their arrival. The research team has built a prototype lunar greenhouse in the CEAC Extreme Climate Lab at UA's Campus Agricultural Center. It represents the last 18 feet of one of several tubular structures that would be part of a proposed lunar base. The tubes would be buried beneath the moon's surface to protect the plants and astronauts from deadly solar flares, micrometeorites and cosmic rays. The membrane-covered module can be collapsed to a 4-foot-wide disk for interplanetary travel. It contains water-cooled sodium vapor lamps and long envelopes that would be loaded with seeds, ready to sprout hydroponically. "We can deploy the module and have the water flowing to the lamps in just ten minutes," said Phil Sadler, president of Sadler Machine Co., which designed and built the lunar greenhouse. "About 30 days later, you have vegetables." Standing beside the growth chamber, which was overflowing with greenery despite the windowless CEAC lab, principal investigator Gene Giacomelli said, "You can think of this as a robotic mechanism that is providing food, oxygen and fresh drinking water." Giacomelli, CEAC director and a professor of agricultural and biosystems engineering, said that although this robot is built around living green plants - instead of the carbon fiber or steel usually associated with engineering devices - it still requires all the components common to any autonomous robotic system. These components, which include sensors that gather data, algorithms to analyze that data and a control system to optimize performance, are being designed by assistant professor Roberto Furfaro of systems and industrial engineering, and associate professor Murat Kacira of agricultural and biosystems engineering. "We want the system to operate itself," Kacira said. "However, we're also trying to devise a remote decision-support system that would allow an operator on Earth to intervene. The system can build its own analysis and predictions, but we want to have access to the data and the control system." This is similar to the way a CEAC food-production system has been operating at the South Pole for the past six years. The South Pole Growth Chamber, where many ideas now used in the lunar greenhouse were developed, was also designed and fabricated by Sadler Machine Co. It provides fresh food to the South Pole research station, which is physically cut off from the outside world for six to eight months each year. In addition to food, the growth chamber provides a valuable psychological boost for scientists who overwinter at the station. "There's only 5 percent humidity and all you can normally smell is diesel fuel and body odor," Sadler said. But now researchers can go into the growth chamber and smell vegetables and flowers and see living green things, breaking the monotony of thousands of square miles of ice and snow surrounding their completely man-made environment. Lane Patterson, a master's student in agricultural and biosystems engineering and primary systems operations manager of CEAC's lunar greenhouse lab, also works for Raytheon Polar Services, which provides operations support for the South Pole Growth Chamber. "If I need to be there in the chamber looking over an operator's shoulder, that's possible with the web camera," Patterson explained. "But if I need to make an adjustment to the chamber without the operator's assistance, I can do that electronically via computer communication." Recycling and efficient use of resources are just as important to the South Pole operation as they will be on the moon, Sadler noted. A dozen 1,000-watt sodium-vapor lights generate a lot of heat, which is siphoned away by each lamp's cooling system and used to heat the station. "Energy is expensive there," Sadler said. "It's about $35 a gallon for diesel fuel." In fact, efficient use of resources is just as important for hydroponic greenhouses anywhere on the globe, Giacomelli emphasized. "All that we learn from the life support system in the prototype lunar greenhouse can be applied right here on Earth," he added. "On another planet, you need to minimize your labor, recycle all you can and operate as efficiently as possible," he said. "If I ask the manager of a hydroponic greenhouse in Willcox [Ariz.] what's most important, he or she will tell me those same things - recycle, minimize labor, minimize resource use." Carbon dioxide is fed into the prototype greenhouse from pressurized tanks, but astronauts would provide CO2 at the lunar base just by breathing. Similarly, water for the plants would be extracted from astronaut urine, and the water-cooled electric lights might be replaced by fiber optic cable - essentially light pipes - which would channel sunlight from the surface to the plants underground. The lunar greenhouse contains approximately 220 pounds of wet plant material that can provide 53 quarts of potable water and about three-quarters of a pound of oxygen during a 24-hour period, while consuming about 100 kilowatts of electricity and a pound of carbon dioxide. "We turned the greenhouse on about eight months ago to see how it would operate and that test run will be completed on Sept. 30," Giacomelli said. NASA is funding that research under a $70,000 Ralph Steckler Space Grant Colonization Research and Technology Development Opportunity, which CEAC obtained with help from UA's Lunar and Planetary Laboratory. The Steckler grants are designed to support research that could lead to space colonization, a better understanding of the lunar environment and creation of technologies that will support space colonies. CEAC now is applying for Phase II of this grant, which would provide an additional $225,000 for two years. Although NASA funds the test run, "everything you see in this room - the greenhouse module, lights, water system - came out of Phil Sadler's pocket," Giacomelli said. "I paid for the student help and pay the bills for the research space. Obviously, we think this is important work." The UA researchers and Sadler Machine also are collaborating with two Italian firms on this project: Thales Alenia Space, a company that builds hardware for the International Space Station, and Aero Sekur, which builds inflatable structures. Giacomelli said the research also could lead to plant colonization in another traditionally hostile environment - large urban centers. "There's great interest in providing locally grown, fresh food in cities, for growing food right where masses of people are living," Giacomelli said. "It's the idea of growing high-quality fresh food that only has to be transported very short distances. There also would be a sense of agriculture returning to the everyday lives of urban dwellers." "I think that idea is as exciting as establishing plant colonies on the moon."

AT: Colonization Impossible—Farming

Soon, Astronauts will be eating salad in space

Xinhua General News Service, 2006 (Xinhua General News Service, Beijing newspaper, “Astronauts look forward to salad days in space” 7/21/06, Lexis)

Fresh salads made with a variety of fruit and vegetables are likely to be top of the menu for future astronauts, says a leading U.S. space scientist. And fresh meat would probably be rare treat in space-based life support systems, said Raymond Wheeler, a crop researcher with the National Aeronautics and Space Administration (NASA). Wheeler, head of NASA's advanced life support program, was exhibiting at space science forum in Beijing vegetables grown hydroponically in a biomass production chamber in Kennedy Space Center. "Tomato, pepper, lettuce, radish and onion -- what we call 'salad crops' -- have all passed tests in different temperatures, light intensities and carbon dioxide concentrations," Wheeler said. Vegetable salads would be the stable food in space. "Though animal protein is also very important, there is an energy advantage in eating plants directly. "If we feed plants to animals and then we eat animals, both the two steps involve energy waste," he said. Cost was always a priority consideration in space technologies and complicated food preparation resulted in more expense. "So there's a big advantage to consider first plants that require little or no processing, like lettuce, strawberries or tomatoes. You can eat them fresh, just wash and chop them." Very little plant research had been carried out in space. All the food astronauts currently needed was shipped from the Earth. It was much cheaper to launch food and oxygen than to build a wasteless biological recycling system in space, except for "perishable" food, Wheeler told the 36th scientific assembly of the Committee on Space Research (COSPAR), which runs from July 17 to 22."Vegetables and fruit cannot be stored for very long in space. If we can grow them locally, they can be very good supplement to the diet," he explained. Lowering pressure and controling light intensity can help cut costs of farming in space. The pressure has been successfully reduced to one-third, or even a quarter of atmosphere at seal level on the Earth, which will save gas injected into the chamber to keep it pressurized, Wheeler said. Light is another typical limiting factor, as the plant yield is almost a linear function of how much light they receive, he said. "But we cannot give all the light as we want, because it either needs electricity or depends on different situations in collecting sunlight." The Moon has 14 days of light and 14 days of dark, and the space station has 60 minutes of light and 30 minutes of dark. Mars has a similar rotating cycle to the Earth, but the light intensity is only 43 percent of that on the Earth, Wheeler explained. Plants can also produce oxygen for space station via photosynthesis. According to Wheeler, 20 square meters of plants can provide oxygen for one person and remove all carbon dioxide he breathes out. About 40 to 50 square meters are needed to provide food for a person, as only a half of the biomass is edible. Only 5 to 10 square meters can meet a person's water needs, if he uses waste water to irrigate crops and condense clean water from what they evaporate. It's a recycling system. Meanwhile, Wheeler said that how to water plants in weightless situation remains to be a major challenge. "We can adopt conventional way of watering on the surface of the Moon and the Mars, like we do on the Earth. But it will become a difficult problem when we goes into the Moon or the Mars."

AT: Colonization Impossible—Lunar Ice

**Lunar ice provides a source of fuel to use on return trips and on missions beyond our moon.**

**Bryner ‘9** (13 November 2009, Jeanna Bryner, Senior writer for space.com, “Water Discovery Fuels Hope to Colonize the Moon”, http://www.space.com/7532-water-discovery-fuels-hope-colonize-moon.html”

Having that store of water on the moon could be a boon to possible future lunar camps. In addition to a source of drinking water, lunar water ice could be broken into its constituent hydrogen and oxygen atoms, ultimately to be used in rocket fuel. That would mean spacecraft ferrying future colonists to the moon would not have to take fuel for the return trip, or the fuel could be used to launch trips beyond the moon. And water could be used as a shield from cosmic radiation. "We now can say ... that the possibility of living off the land has just gone up a notch," said Peter Schultz, professor of geological sciences at Brown University and a co-investigator on the LCROSS mission, referring to past detections of water on the moon.

AT: Cost/Feasibility

Lunar mining is totally within our realm of possibility—heavy lift launch vehicles and tech innovation makes setting up a base pretty simple

Spudis and Lavoie ’10 Paul D. Spudis, Senior Staff Scientist at the Lunar and Planetary Institute and former Deputy Leader of the Science Team for the Department of Defense Clementine mission to the Moon, Tony Lavoie, NASA Marshall Space Flight Center, “Mission and Implementation of an Affordable Lunar Return,” Space Manufacturing 14, 19 December 2010, http://www.spudislunarresources.com/Papers/Affordable\_Lunar\_Base.pdf

At least three different studies examined the cost problems of the ESAS architecture and offered alternatives that cost less, take less development time, and are adequate for lunar surface return. One approach uses the commercially available Delta IV and Atlas V Evolved Expendable Launch Vehicles (EELV) and orbital propellant depots to perform lunar return (Zegler et al., 2009). This approach has the advantage of using existing launch vehicles but development of propellant depots is required to permit journeys beyond LEO. Two other approaches use existing Shuttle hardware to create new launch vehicles capable of launching lunar spacecraft in two or three pieces, which are then assembled in low Earth orbit for trips outward. Two concepts – DIRECT and Shuttle side-mount (SSM) – take advantage of the existing space industrial base, including tooling and assembly facilities, as well as the existing processing and launch infrastructure at Kennedy Space Center, to create new vehicles that can deliver tens of metric tonnes to LEO. The advantage of this approach is that we launch what is needed to go to the Moon complete and no depots are required; the disadvantage is that there is some new vehicle development needed. The use of existing Shuttle piece parts keeps this to a minimum. We assume the use of multiple launch vehicles, using the best available assets to meet given payload and mission requirements, including EELV to launch early lunar surface robotic assets. A Delta IV Heavy and large Atlas V (551) can place 1-2 mT on the surface of the Moon. This is enough payload capacity to deliver significant capability to the Moon. We begin by conducting detailed robotic site exploration and characterization of the poles. We know enough to pick promising landing sites, however, strategic knowledge about the physical state, distribution, conditions and quantities of lunar volatiles must be gathered from surface lander and rover missions. The development of a heavy-lift vehicle adds capability to our architecture but is not an absolute requirement for early missions, although we recognize that other strategic considerations (such as preservation of HLV infrastructure) may require the near-term development of such a vehicle. A Shuttle-derived vehicle has the least impact on existing facilities and the least amount of new development and thus, lower total cost. A single Shuttle side-mount (SSM) can launch about 70 mT to LEO and place 8-9 mT on the lunar surface. Two SSM launches can fly an entire human lunar mission; this is an important capability in the lunar return program. Once we have established a foothold on the Moon and have the capability to at least partly supply ourselves from lunar materials, the need for a very heavy lift vehicle lessens. In fact, the best time for the creation of propellant depots is after we are able to supply them with lunar propellant. Such an approach makes human planetary missions easier; the dead weight of propellant (at least 80% of the total mass of the spacecraft for a human Mars mission) need not come from the deep gravity well of Earth. Much of the current debate about launch vehicles stems from the mission or objective of human flights beyond LEO. We believe that the fundamental objective of such flight is to extend human reach and presence from its current limitation in LEO to all levels of space beyond. To that end, we are agnostic on the need for any specific launch vehicle solution; our goal is to make complete dependence on such vehicles unnecessary as rapidly as possible through the use of offplanet resources. If a heavy lift vehicle is available early in the program, we will use it. If one is not, we will use other launch vehicles. Because we must scope the total effort within an assumed budget profile that would be available to NASA for any launch vehicle development as well as all mission hardware development, we developed an architecture that accomplishes the goal while fitting under the budget. We assume that a medium heavy lift launch vehicle (~70 mT) will be available during the later phases of our program (when humans are needed on the Moon.) Our particular architecture uses such a vehicle and reflects the cost of its development and operations, but other solutions are possible within the assumed budget wedge used by the Augustine Committee (2009).

AT: Mining Impossible

Technology for mining accessible – NASA lunabotics contest proves

Brown ’11(Keri, West Virginia Public Broadcasting, Charleston Gazette- West Virginia, 2011, “WVU takes 3rd in lunar mining robotics event”, Nexus, 07/05/2011) DOA: 07/19/2011

A team of students from the WVU College of Engineering and Mineral Resources recently placed third at NASA's Lunabotics Mining Competition. The team of graduate and undergraduate students from WVU placed third overall. Student team leader Ben Knabenshue said the experience was challenging. "We had to design for a lunar environment so we couldn't use hydraulics and rubber tires and things that we take for granted here on Earth because they don't work in lower gravity," said Knabenshue. He added, "You know we were separated from the robot and we couldn't actually see it as we were operating it, so we put lots of sensors on there and video cameras so we could simulate actually operating this from a control back on Earth while it was deployed on the moon." The West Virginia students named their 180-pound robot Mountaineer. During the competition, students have 15 minutes to complete an obstacle course in a simulated lunar arena. Once the robot makes it to the mining area, it picks up "lunar soil" samples and places them in a bin. The goal is to collect as many of the samples as possible within the time limit. Powsiri Klinkhachorn, a professor of computer science and electrical engineering at West Virginia University, served as the faculty adviser for the team. He said as it winds down its space shuttle program, NASA is looking at other ways to advance future space exploration. "In order to get there, the moon is probably the first settlement that you can actually think if you will, before we get to Mars or to some other planet. That is the first step if you can go there, start to dig out the moon surface or soil and be able to extract the oxygen and other minerals and resources from there, so you can have a life sustaining environment, said Klinkhachorn. Knabenshue said he hopes his experience will inspire other students to pursue careers in science, technology, engineering and math fields. "We went to events that many local students would be at such as the Monongalia County Eighth Grade Career day," he said. "And to just have the students come around you know these eighth graders are just kind of figuring out what they want to do with their life and to sit there and play with these robots, and understand some of the design that we put into it; we had a lot of students come back and say I want to be an engineer now, this is so cool, so it really let us reach out into the community and recruit more people in those STEM fields." Following the team's third-place win, the students from the West Virginia University College of Engineering and Mineral Resources (CEMR) will be heading back to the Kennedy Space Center on Friday to watch the very last space shuttle flight before NASA retires the 30-year program.

AT: Mining Impossible

Lunar resources accessible; can further exploration of solar system

Excell Editor of the Engineer ’09 (John, *The Engineer*, 2009, “Space Exploration: Mining the Moon”, Nexus, 04/20/2009) DOA: 07/19/2011

With the space race back on, engineers are considering the potential of using lunar resources to fuel further exploration of the solar system.. A host of probes and orbiters are scheduled for launch and manned missions are expected to follow. Both the US and Russia have stated their intentions to put men back on the Moon by 2025, while Europe, India, China and Japan are also mulling over the options. And while a trip to the Moon is still a potent political symbol, today's motivations for getting there are more varied than they were last time around. For a start, with the few samples returned by the nine manned lunar missions outliving their usefulness many years ago, there is unfinished scientific business. But beyond this, the Moon is increasingly seen as in important staging post to the further exploration of the solar system; its low gravity making lift-off a far less energy-intensive process than it is on Earth. To do all of this will require a long-term manned presence on the Moon, and indeed both the US and Russia are also planning manned lunar bases. The problem is that with current technology it's simply not possible to take enough food, water and fuel to last for much longer than a few days. That is why a loose-knit alliance of space scientists and members of the mining community are increasingly considering the development of so- called In Situ Resource Utilisation (ISRU) techniques that will enable the next generation of astronauts to make use of their destination's raw materials. Some pretty bold claims have been made about mineral resources on the Moon, but according to Birkbeck College planetary scientist Dr Ian Crawford the first challenge is finding out exactly what is up there.'There's a certain amount of jumping the gun in some quarters about lunar resources,' said Crawford. 'The truth of the matter is we haven't actually yet explored the Moon enough to know whether there is anything economically useful there or not.' With the six Apollo landings and three Russian landings all bringing back samples from the same general area on the near side close to the equator we still have a great deal to find out. 'Most of the Moon is pretty much unexplored with the exception of what can be seen by remote sensing from orbital instruments,' added Crawford, who is also project lead on MoonLite, a UK plan to create a network of sensors on the Moon by firing projectiles into its surface (The Engineer June 2008). One of the most useful resources that is thought to be present on the Moon is the water ice that scientists believe may exist in the shadowed craters at the lunar poles. Deposited by comets, water ice, if present in large enough quantities, could provide many of the materials essential for a long stay in space, explained Crawford. 'If you've got ice, you've got a supply of water that is useful in itself and it is electrolysable into hydrogen and oxygen - your two main rocket propellants of choice.' So far, evidence of ice deposits is based on the rather sketchy data acquired from an instrument flown around the Moon on the lunar prospector spacecraft in the late 1990s. But Crawford is hopeful that NASA's Lunar Reconnaissance Orbiter (LRO), which is scheduled for launch this June and able to detect smaller quantities of ice, will provide a clearer picture. Another lunar resource that is often spoken about is Helium 3 (He-3), a non-radioactive isotope of helium that some have suggested could even be mined on the Moon and brought back to Earth to power future fusion reactors. Crawford is sceptical. 'We know He-3 is present in the lunar regolith because it has been extracted from the Apollo samples, but it is present in the Apollo samples in such small amounts - of the order of 10 parts per billion - that the amount you would need to make a significant difference for nuclear energy production on earth would mean strip mining thousands of square kilometres of lunar surface.' But He-3 could have potential for powering future spacecraft propulsion systems. 'In the context of future space nuclear power systems where you'd require much more modest quantities, then, assuming a He-3 reactor is ever made to work, He-3 might be less unrealistic.' But even if there is no ice and He-3 turns out to be a dead end, the moon still has plenty to offer, and numerous scientists have devised methods for extracting both hydrogen and oxygen from the lunar regolith itself. Carole McLemore, project lead for NASA's ISRU programme, is currently looking at different methods of extracting aluminium and titanium from lunar rock for use in fabrication processes on the Moon. According to McLemore, NASA's vision is that astronauts will be able to use rapid- manufacturing techniques in order to produce components and tools from lunar metals.

AT: Mining Impossible

Lunar Mining for REEs easier than mining on Earth

Simon ‘7 (William E. Simon Chair in Political Economy, Center for Strategic and International Studies, Georgetown University and Senior Research Fellow, Hoover Institution, Stanford University. “Hegemony’s Cost,” 11/2/2007, <http://www.informationclearinghouse.info/article18654.htm)-INTITIALS>

As a global trade war over rare earth elements continues to escalate, a seemingly impossible-to-reach discovery is grabbing headlines around the world. According to the British journal Nature Geoscience, Japanese researchers have found massive rare earth deposits on the floor of the Pacific Ocean, totalling somewhere between 80 billion and 100 billion tonnes. To put that in perspective, reserves on land are thought to be about 110 million tonnes. The discoveries are spread across international waters and lie in sea mud as much as 6,000 metres below the surface. Mining them remains nothing more than a whimsical dream at this point, and many experts doubt it will ever happen. "Costs would be exorbitant. Mining at 5,000 to 6,000 metres below the surface would be harder than mining on the moon. Plain nonsense," one rare earth executive said. But that has not stopped commentators from taking the discovery seriously, and the reason is obvious: The world depends on China to supply the critical rare earths, and China is proving to be a very unreliable source. There are 17 rare earth elements, which go by nearly unpronounceable names like yttrium, promethium, dysprosium and praseodymium. Over the past several years, demand for these metals has skyrocketed as they have important uses in green energy, consumer electronics, hybrid vehicles and many other applications. Despite the "rare" designation, these metals are abundant around the world. However, China currently controls more than 95% of global supply. It is a result of the country's ultra-low-cost production, much of which comes from a tailings dump in Inner Mongolia. Back in the 1990s, China put its competitors out of business with dirt-cheap exports. Yet over the past few years, China moved in the other direction and placed increasingly tight restrictions on exports. That has infuriated countries such as Japan and the United States that rely on those exports to drive their high-tech industries. Beijing appears to be trying to use its control over rare earth supply to force foreign companies to move their value-added supply chains to China. The next step could be a battle at the World Trade Organization. On Tuesday, the WTO declared that Chinese export restrictions on nine raw materials violate global trade rules and give its domestic manufacturers an unfair advantage. While the ruling did not cover rare earths, it could encourage the United States and other countries to file a WTO complaint specifically tied to rare earths. China slashed rare earth exports 40% in the 2010, and another 11% in the first half of 2011. The announcement of the seafloor discovery comes just days before yet another Chinese export cut is anticipated. The concept of mining the seafloor is well understood and advanced. One company, Nautilus Minerals Inc., plans to be mining copper and gold off the ocean floor as soon as 2013 from a deposit near Papua New Guinea. But the Nautilus deposit is only about 1,600 metres below the surface. The rare earth finds are much deeper and have much trickier geology. "There's never been a mine in production at anywhere near those depths, and there won't be in our lifetime," said Al Shefsky, president of rare earth explorer Pele Mountain Resources Inc. Many experts also believe these undersea deposits are not necessary, as rare earth projects are popping up on land all around the world. They are expected to gradually reduce China's grip on the industry, though it will take several years before many of them reach production. One company, Molycorp Inc., is already producing rare earths at its Mountain Pass mine in California

AT: Mining Impossible

Lunar Mining for REEs easier than mining on Earth

Koven 2011 (Peter Koven, Financial Post. “Rare earth sea change unlikely; Pacific Ocean find too deep to mine easily,” 7/6/11)

As a global trade war over rare earth elements continues to escalate, a seemingly impossible-to-reach discovery is grabbing headlines around the world. According to the British journal Nature Geoscience, Japanese researchers have found massive rare earth deposits on the floor of the Pacific Ocean, totalling somewhere between 80 billion and 100 billion tonnes. To put that in perspective, reserves on land are thought to be about 110 million tonnes. The discoveries are spread across international waters and lie in sea mud as much as 6,000 metres below the surface. Mining them remains nothing more than a whimsical dream at this point, and many experts doubt it will ever happen. "Costs would be exorbitant. Mining at 5,000 to 6,000 metres below the surface would be harder than mining on the moon. Plain nonsense," one rare earth executive said. But that has not stopped commentators from taking the discovery seriously, and the reason is obvious: The world depends on China to supply the critical rare earths, and China is proving to be a very unreliable source. There are 17 rare earth elements, which go by nearly unpronounceable names like yttrium, promethium, dysprosium and praseodymium. Over the past several years, demand for these metals has skyrocketed as they have important uses in green energy, consumer electronics, hybrid vehicles and many other applications. Despite the "rare" designation, these metals are abundant around the world. However, China currently controls more than 95% of global supply. It is a result of the country's ultra-low-cost production, much of which comes from a tailings dump in Inner Mongolia. Back in the 1990s, China put its competitors out of business with dirt-cheap exports. Yet over the past few years, China moved in the other direction and placed increasingly tight restrictions on exports. That has infuriated countries such as Japan and the United States that rely on those exports to drive their high-tech industries. Beijing appears to be trying to use its control over rare earth supply to force foreign companies to move their value-added supply chains to China. The next step could be a battle at the World Trade Organization. On Tuesday, the WTO declared that Chinese export restrictions on nine raw materials violate global trade rules and give its domestic manufacturers an unfair advantage. While the ruling did not cover rare earths, it could encourage the United States and other countries to file a WTO complaint specifically tied to rare earths. China slashed rare earth exports 40% in the 2010, and another 11% in the first half of 2011. The announcement of the seafloor discovery comes just days before yet another Chinese export cut is anticipated. The concept of mining the seafloor is well understood and advanced. One company, Nautilus Minerals Inc., plans to be mining copper and gold off the ocean floor as soon as 2013 from a deposit near Papua New Guinea. But the Nautilus deposit is only about 1,600 metres below the surface. The rare earth finds are much deeper and have much trickier geology. "There's never been a mine in production at anywhere near those depths, and there won't be in our lifetime," said Al Shefsky, president of rare earth explorer Pele Mountain Resources Inc. Many experts also believe these undersea deposits are not necessary, as rare earth projects are popping up on land all around the world. They are expected to gradually reduce China's grip on the industry, though it will take several years before many of them reach production. One company, Molycorp Inc., is already producing rare earths at its Mountain Pass mine in California

Plan Popular

Plan is popular, would increase political capital.

Whitesides 08 (George T. Whitesides executive director national space society before the subcommittee on space, aeronautics, and related sciences, Senate Hearing on “Reauthorizing the Vision for Space Exploration” May 7, 2008 Chairman Nelson, Ranking Member Vitter, and members of the subcommittee. <http://www.spaceref.com/news/viewsr.html?pid=27921> )

One of the virtues, but also one of the challenges, of living in an elected, representative government is that personnel and priorities constantly change. Fortunately, the nation as a whole, the Congress, and the president have all seen the value of supporting space-related activities since the initial space race of the 1950s. While that support has waxed and waned over the years, the Gallup organization reports that the percent of Americans who want NASA’s budget to remain the same or increase has never been lower than 51 percent since 1984.

I take that as a hopeful sign for what we can accomplish in the future. This nation has always stood for progress, expanding the frontiers of the possible, and improving the lot of its citizens. If the American people are willing to maintain a consistent belief in the value of space exploration, then I believe any future president or Congress would be safe in continuing this valuable national investment. It is about more than following the polls; it is about continuing to support an activity that, to the majority of Americans, stands for progress and a better future. It also means demonstrating this nation’s commitment to being a leader in high technology of all kinds. Space exploration is a national emblem of achievement and soft power of which its citizens can be justly proud. Support for the Vision, then, is not just a matter of material support in the form of passing budgets every year; it is a national enterprise that deserves our constant verbal and moral support.

AT: Spending DA

Mining Helium3 and water on the moon is cost effective

Koven, National Post ’11 (Peter, Financial Post Business Magazine, April 5, Lexis, “The Outer Limits; Mining The Moon? The Arctic? Underwater? These One-Time Crazy Ideas Are Fast Becoming Reality As Companies Challenge Geographical Boundaries To Find Precious Commodities”)

There is, however, logic behind moon mining. A 2009 NASA mission showed the moon potentially holds massive reserves of water. That could be important because shipping water from earth into outer space is extremely costly -- the equivalent of one bottle costs about US$10,000. But with an affordable supply already on location, NASA could then use moon water to re-fuel satellites in orbit or convert the water into oxygen to breathe. Mining technology could also play a key role in constructing an underground moon base, a longtime goal of NASA, or to extract a scarce commodity called helium-3 (thought to be abundant on the moon) that is useful in nuclear fusion. "For a long time I thought, 'Nah, moon mining is never going to happen.' Now I know it's going to happen. It's just a matter of when," says Baiden, a former senior executive at Inco. Some experts think it could be as soon as 2020.

NEG—AT: Leadership

US is too far ahead to lose leadership in space

Jonathan Adams, “Dragon watch: China pulls ahead in moon race,” Global Post, 11/2/2010, http://www.globalpost.com/dispatch/china/101027/space-race-moon

Not necessarily. Experts say both China and India still lag far behind the United States in space expertise and experience. After all, American astronauts bounded over the moon's surface more than 40 years ago. President Barack Obama himself downplayed the importance of manned moon missions earlier this year, saying bluntly "we've been there."

U.S. spacecraft and satellite technology is still cutting-edge; witness the high-tech American lunar orbiter that's now sharing the moon's skies with China's orbiter. And the United States is now aiming for a daring new stunt: landing an astronaut on an asteroid by 2025, a project dubbed "Plymouth Rock."

NEG—AT: Economy

Economic decline doesn’t cause war

Miller 2k

Morris Miller, "Poverty as a cause of wars?" Interdisciplinary Science Reviews, Vol. 25 Issue 4, Winter 2000, proquest

The question may be reformulated. Do wars spring from a popular reaction to a sudden economic crisis that exacerbates poverty and growing disparities in wealth and incomes? Perhaps one could argue, as some scholars do, that it is some dramatic event or sequence of such events leading to the exacerbation of poverty that, in turn, leads to this deplorable denouement. This exogenous factor might act as a catalyst for a violent reaction on the part of the people or on the part of the political leadership who would then possibly be tempted to seek a diversion by finding or, if need be, fabricating an enemy and setting in train the process leading to war. According to a study undertaken by Minxin Pei and Ariel Adesnik of the Carnegie Endowment for International Peace, there would not appear to be any merit in this hypothesis. After studying ninety-three episodes of economic crisis in twenty-two countries in Latin America and Asia in the years since the Second World War they concluded that:19 Much of the conventional wisdom about the political impact of economic crises may be wrong ... The severity of economic crisis - as measured in terms of inflation and negative growth - bore no relationship to the collapse of regimes ... (or, in democratic states, rarely) to an outbreak of violence ... In the cases of dictatorships and semidemocracies, the ruling elites responded to crises by increasing repression (thereby using one form of violence to abort another).

NEG—AT: Competitiveness

Data shows that competition is irrelevant and over determined by domestic productivity

Paul Krugman [Economist, after this was published he received the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel] “Competitiveness: A Dangerous Obsession”. Foreign Affairs, 00157120, Mar/Apr94, Vol. 73, Issue 2

There is no reason, however, to leave this as a pure speculation; it can easily be checked against the data. Have deteriorating terms of trade in fact been a major drag on the U.S. standard of living? Or has the rate of growth of U.S. real income continued essentially to equal the rate of domestic productivity growth, even though trade is a larger share of income than it used to be? To answer this question, one need only look at the national income accounts data the Commerce Department publishes regularly in the Survey of Current Business. The standard measure of economic growth in the United States is, of course, real GNP--a measure that divides the value of goods and services produced in the United States by appropriate price indexes to come up with an estimate of real national output. The Commerce Department also, however, publishes something called "command GNP." This is similar to real GNP except that it divides U.S. exports not by the export price index, but by the price index for U.S. imports. That is, exports are valued by what Americans can buy with the money exports bring. Command GNP therefore measures the volume of goods and services the U.S. economy can "command"--the nation's purchasing power rather than the volume it produces.[3] And as we have just seen, "competitiveness" means something different from "productivity" if and only if purchasing power grows significantly more slowly than output. Well, here are the numbers. Over the period 1959-73, a period of vigorous growth in U.S. living standards and few concerns about international competition, real GNP per worker-hour grew 1.85 percent annually, while command GNP per hour grew a bit faster, 1.87 percent. From 1973 to 1990, a period of stagnating living standards, command GNP growth per hour slowed to o. 65 percent. Almost all (91 percent) of that slowdown, however, was explained by a decline in domestic productivity growth: real GNP per hour grew only 0.73 percent. Similar calculations for the European Community and Japan yield similar results. In each case, the growth rate of living standards essentially equals the growth rate of domestic productivity--not productivity relative to competitors, but simply domestic productivity. Even though world trade is larger than ever before, national living standards are overwhelmingly determined by domestic factors rather than by some competition for world markets.

NEG—Mining Doesn’t Solve

Lunar mining is too costly and unfeasible to solve

Mark Whittingon, “Moon Express Proposes Lunar Mining Operations,” Yahoo News, 4/11/2011, http://news.yahoo.com/moon-express-proposes-lunar-mining-operations-20110411-120600-863.html

No one has been on the moon since 1972. The last human-made object to soft land on the lunar surface was a Soviet built rover in the mid-1970s. U.S. President Barack Obama has specifically ruled out the moon as a destination for Americans.

All of that has not daunted Moon Express Inc., a Silicon Valley startup that intends to send rovers to prospect for metals and rare Earth minerals on the lunar surface. Moon Express has already gotten a $10 million NASA data purchase contract. In addition, the company is an entrant in the $30 million Google Lunar X-Prize. The Lunar X-Prize would dole out money to the first private group that lands an instrument package on the lunar surface, have it explore within a third of a mile of the landing site and return high definition images and video.

While Moon Express is somewhat vague about what it would do with lunar resources once they are found, the company and its founders cannot be faulted for not dreaming big, Mining the Moon, to support a settlement and to support further exploration throughout the solar system, as well as to benefit Earth has been a dream held by space enthusiasts for decades. Moon Express constitutes an attempt to translate this dream into reality.

One of the impediments to large scale mining of the moon's resources is the high cost of returning them to Earth. If practical fusion energy were to become a reality, helium 3, a substance that does not occur naturally on Earth, might be worth it at current transportation costs. But even rare earths may not achieve a cost/benefit ratio that would make mining it on the Moon profitable.

Another impediment is the lack of law governing property rights on other celestial bodies such as the moon. There is nothing in international law that forbids a private company from extracting resources from the moon. But the law is silent, so far, on rights to hold property, including land and mineral rights, on the moon. There is no mechanism to resolve disputes between private companies, such as overmining claims.

For large-scale lunar mining to take place, these questions need to be resolved by international agreement. It would also be useful to have a human presence on the moon, in the form of a lunar settlement, to be a core market for lunar mining entrepreneurs. If that settlement is to be American, a change of policy and likely a change of administration would be required.

NEG—Helium-3 Doesn’t Solve Fusion

Helium-3 doesn’t solve fusion—it’s way less efficient than current (failing) efforts

Mark Williams, “Mining the Moon,” Technology Review, published by MIT, 23 August 2007, <http://www.technologyreview.com/energy/19296/page1/>

Helium-3 advocates claim that it, conversely, would be nonradioactive, obviating all those problems. But a serious critic has charged that in reality, He3-based fusion isn't even a feasible option. In the August issue of Physics World, theoretical physicist Frank Close, at Oxford in the UK, has published an article called "Fears Over Factoids" in which, among other things, he summarizes some claims of the "helium aficionados," then dismisses those claims as essentially fantasy. Close points out that in a tokamak--a machine that generates a doughnut-shaped magnetic field to confine the superheated plasmas necessary for fusion--deuterium reacts up to 100 times more slowly with helium-3 than it does with tritium. In a plasma contained in a tokamak, Close stresses, all the nuclei in the fuel get mixed together, so what's most probable is that two deuterium nuclei will rapidly fuse and produce a tritium nucleus and proton. That tritium, in turn, will likely fuse with deuterium and finally yield one helium-4 atom and a neutron. In short, Close says, if helium-3 is mined from the moon and brought to Earth, in a standard tokamak the final result will still be deuterium-tritium fusion. Second, Close rejects the claim that two helium-3 nuclei could realistically be made to fuse with each other to produce deuterium, an alpha particle and energy. That reaction occurs even more slowly than deuterium-tritium fusion, and the fuel would have to be heated to impractically high temperatures--six times the heat of the sun's interior, by some calculations--that would be beyond the reach of any tokamak. Hence, Close concludes, "the lunar-helium-3 story is, to my mind, moonshine."

NEG—Helium-3 Doesn’t Solve Energy

Moon not the answer to resource scarcity, Helium-3 will run out

Hatch 10 (Hatch, Benjamin D. Executive Notes and Comments Editor, Emory International Law Review. “DIVIDING THE PIE IN THE SKY: THE NEED FOR A NEW LUNAR RESOURCES REGIME.” Vol. 24 Rev. 229. 2010. <http://www.gpo.gov/fdsys/pkg/CHRG-108hhrg92757/pdf/CHRG-108hhrg92757.pdf>.

While harvesting Helium-3 would obviously not destroy the Moon, it is important to note that even Moon rocks that contain Helium-3, or other resources, are not infinitely renewable.186 The Moon is not expanding—it has a fixed mass, and, given sufficient time, the Moon could be harvested until even Helium-3 saturated Moon rocks become as rare as today’s fossil fuels. In light of this reality, and despite the temporal distance until the point when lunar environmental harms become a bitter reality, environmental protections for the Moon are not only a wise decision but help to guarantee the Moon’s presence as both a decoration in the night sky and a potential source of valuable minerals for future generations. However, the current economic problem for the Moon is not a tragedy of e commons. Instead, the most important economic problem facing the Moon is a reversal of the tragedy of the commons.187 This argument postulates that the Moon, rather than being harmed by over-utilization, has been harmed by a legal regime that creates too many disincentives for development.188 Specifically, the Moon is claimed to be part of the “common heritage of mankind,” a phrase also found in the Law of the Sea, which has denied humanity the gains that space exploration and lunar development would otherwise have created.

NEG--AT: H-3 k2 Nuke Detection

Alternatives to helium-3 solve radiation detection

“AAAS Workshop Explores How to Meet Demand for Helium-3 in Medicine, Industry, and Security,” American Association for the Advancement of Science (AAAS), 4/23/2010, http://www.aaas.org/news/releases/2010/0423helium3.shtml

Richard Kouzes, a laboratory fellow in the Pacific Northwest National Laboratory in Richland, Washington, said that alternatives for helium-3 for national security had to fit certain parameters. For instance, neutron detection systems have to physically fit into existing detection systems, which use long tubes containing helium-3. Some possible alternatives to helium-3 are detectors filled with boron trifluoride (BF3) or lined with boron, which are two “existing alternatives that can be deployed today,” Kouzes said. Plastic fibers coated with lithium-6 are another possible alternative. Kouzes has tested these alternatives and said that they potentially will work for deployment, but that they will require hardware and software modifications and integration testing.

NEG—AT: Terrorism

There’s no threat from terrorism

John Mueller, Professor of Political Science at Ohio State University, “Is There Still A Terrorist Threat?” Foreign Affairs, September/October 2006, http://www.foreignaffairs.org/20060901facomment85501/john-mueller/is-there-still-a-terrorist-threat.html?mode=print

THREAT PERCEPTIONS The results of policing activity overseas suggest that the absence of results in the United States has less to do with terrorists' cleverness or with investigative incompetence than with the possibility that few, if any, terrorists exist in the country. It also suggests that al Qaeda's ubiquity and capacity to do damage may have, as with so many perceived threats, been exaggerated. Just because some terrorists may wish to do great harm does not mean that they are able to. Gerges argues that mainstream Islamists -- who make up the vast majority of the Islamist political movement -- gave up on the use of force before 9/11, except perhaps against Israel, and that the jihadists still committed to violence constitute a tiny minority. Even this small group primarily focuses on various "infidel" Muslim regimes and considers jihadists who carry out violence against the "far enemy" -- mainly Europe and the United States -- to be irresponsible, reckless adventurers who endanger the survival of the whole movement. In this view, 9/11 was a sign of al Qaeda's desperation, isolation, fragmentation, and decline, not of its strength. Those attacks demonstrated, of course, that al Qaeda -- or at least 19 of its members -- still possessed some fight. And none of this is to deny that more terrorist attacks on the United States are still possible. Nor is it to suggest that al Qaeda is anything other than a murderous movement. Moreover, after the ill-considered U.S. venture in Iraq is over, freelance jihadists trained there may seek to continue their operations elsewhere -- although they are more likely to focus on places such as Chechnya than on the United States. A unilateral American military attack against Iran could cause that country to retaliate, probably with very wide support within the Muslim world, by aiding anti-American insurgencies in Afghanistan and Iraq and inflicting damage on Israel and on American interests worldwide. But while keeping such potential dangers in mind, it is worth remembering that the total number of people killed since 9/11 by al Qaeda or al Qaeda­like operatives outside of Afghanistan and Iraq is not much higher than the number who drown in bathtubs in the United States in a single year, and that the lifetime chance of an American being killed by international terrorism is about one in 80,000 -- about the same chance of being killed by a comet or a meteor. Even if there were a 9/11-scale attack every three months for the next five years, the likelihood that an individual American would number among the dead would be two hundredths of a percent (or one in 5,000). Although it remains heretical to say so, the evidence so far suggests that fears of the omnipotent terrorist -- reminiscent of those inspired by images of the 20-foot-tall Japanese after Pearl Harbor or the 20-foot-tall Communists at various points in the Cold War (particularly after Sputnik) -- may have been overblown, the threat presented within the United States by al Qaeda greatly exaggerated. The massive and expensive homeland security apparatus erected since 9/11 may be persecuting some, spying on many, inconveniencing most, and taxing all to defend the United States against an enemy that scarcely exists.

NEG—AT: Resource Wars

Resource wars won’t occur

Daniel Deudney**,** Fellow in Science, Technology, and Politics, Princeton University, MILLENIUM, 1990, p. 471-

Second, the prospects for resource wars are diminished, since states find it increasingly difficult to exploit foreign resources through territorial conquest. Although the invention of nuclear explosives has made it easy and cheap to annihilate humans and infrastructure in extensive areas, the spread of small arms and national consciousness has made it very costly for an invader, even one equipped with advanced technology, to subdue a resisting population—as France discovered in Indochina and Algeria, the United States in Vietnam and the Soviet Union in Afghanistan.

NEG—International Law CP

Changing international law is a prerequisite to peaceful cooperation in space and on the moon—solves resource competition

Hatch 10 (Hatch, Benjamin D. Executive Notes and Comments Editor, Emory International Law Review. “DIVIDING THE PIE IN THE SKY: THE NEED FOR A NEW LUNAR RESOURCES REGIME.” Vol. 24 Rev. 229. 2010. <http://www.gpo.gov/fdsys/pkg/CHRG-108hhrg92757/pdf/CHRG-108hhrg92757.pdf>.

This Comment has operated under the assumption that two overarching values should be reflected in resource management: international peace and economic efficiency. Before examining the substance of a new lunar-resource regime, states seeking to modify existing space law must evaluate whether these are the values that should inform the new legal system for the Moon. International peace is probably the core value of international law. The first Article of the United Nations Charter begins by stating that “[t]he Purposes of the United Nations are: (1) [t]o maintain international peace and security . . . .”375 It would be difficult to imagine an international resource- management scheme that would not be premised on the goal of promoting peaceable dispute settlement. Regardless of what other values such a system would seek to maximize, like economic efficiency or environmental protection, a regime not fundamentally premised on minimizing the chance of armed conflict would only lead to chaos and catastrophe. Accordingly, the fundamental value protected by any lunar system should be the maintenance of international peace and non-violent dispute settlement. The value of economic efficiency, however, may be a less obvious guide for a new approach to Moon minerals. In tension with economic efficiency is the value of environmental protection, a value recognized in both the OST and the Moon Agreement, as well as in the Madrid Protocol. While some international regimes have sought to combine market economics and environmentalism, including the Kyoto Protocol and CRAMRA, fundamentally states must make a choice whether to permit any lunar-resource exploitation or to categorically ban any such exploitation in the name of the lunar environment.376 Blurring this choice risks political disaster. If states are concerned about the Moon’s environment to the point where they would seek to deny any lunar-resource exploitation at all, then the current regimes of the OST and the Moon Agreement should be replaced by a more stringent environmental-protection agreement, explicitly and unequivocally banning any non-scientific uses of lunar minerals. A successful model for this approach was described in the case study examining the Madrid Protocol, a regime that might have left Antarctica undeveloped economically, but that has successful.

NEG—Colonialism K Link

The Moon is the next frontier for colonialism and conflict

Hatch 10 (Hatch, Benjamin D. Executive Notes and Comments Editor, Emory International Law Review. “DIVIDING THE PIE IN THE SKY: THE NEED FOR A NEW LUNAR RESOURCES REGIME.” Vol. 24 Rev. 229. 2010. <http://www.gpo.gov/fdsys/pkg/CHRG-108hhrg92757/pdf/CHRG-108hhrg92757.pdf>.

The historical conflicts over imperialist regimes and colonialism tend to suggest that when powerful states have an interest in amassing something that exists in large, previously un-owned quantities in one location, they will inevitably come into conflict with one another. States have a limited economic interest in the Antarctic,218 and so they are unlikely to invest military assets and the necessary financing to vindicate or broaden their claim to something that is not generating them any wealth. In contrast, states seem to believe that they have potentially great economic interests in the Moon and, accordingly may have a correspondingly large motivation to have conflicts over it.219

Exploration of the Moon will benefit humanity—on Earth, new technologies will be have to be developed to aid states in the new space race— and on the Moon, providing new opportunities for human growth and expansion.220 Whatever name a regime wants to give to the Moon—res nullius or res communes—the Moon represents an unparalleled opportunity. Imagine a situation where one state was able to not only find large quantities of Helium-3 or some other valuable resource on the Moon but also succeeded in denying access to other states. That state would enjoy a tremendous economic advantage by cornering the market in some ultra-rare, useful commodity. Resources by their nature breed conflict.221 As demonstrated above, states will soon be converging on the Moon to reap the benefits that it may provide. Given the recent actions by the United States and China, and the spirit of conquest and competition that seems to be informing the current Moon rush, the vague and generic OST will not be able to sufficiently stop state conflict over the greatest economic opportunity in history.